OCTOBER 13, 2004

FINAL
PILOT EXTRACTION AND AQUIFER RESPONSE TEST
WORKPLAN
MONTROSE SITE
TORRANCE, CALIFORNIA
DSGWRD 26 – 036

PREPARED FOR:
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

Mission City Corporate Center
2365 Northside Drive, Suite C-100
San Diego, CA 92108
Phone: 619.521.0165
Fax: 619.521.8580

25th
Anniversary
2004

October 13, 2004

VIA FEDERAL EXPRESS

Mr. Jeffrey Dhont
Superfund Project Manager
U.S. ENVIRONMENTAL PROTECTION AGENCY
75 Hawthorn Street (SFD-7-1)
San Francisco, CA 94105-3901

Re: Submittal of Final Workplan for Pilot Extraction and Aquifer Response Test, Montrose Site, Torrance, California

Dear Mr. Dhont:

Enclosed are replacement pages for your copies of the final report titled:

Final
Workplan for Pilot Extraction
And Aquifer Response Test
Montrose Site
Torrance, California
DSGWRD 26-**036**

Transmitted are the report cover and spine; the text revision 1.0, Figures 11 through 19; Appendix A text; Appendix A Tables A-4 and A-10; and Appendix A Figures A-3 through A-6. Please replace the relevant pages of the draft document dated June 11, 2004 with these replacement pages.

This report is being submitted to the U. S. Environmental Protection Agency (EPA) in accordance with the statement of work for the Unilateral Administrative Order for Initial Groundwater Remedial Design Activities.

This document has been prepared to incorporate responses to EPA comments received in correspondence dated August 23, 2004 (Attachment 1).

If you have any questions or comments, please contact us.

Sincerely,
HARGIS + ASSOCIATES, INC.

Michael G. Palmer

Michael A. Palmer, RG 5915, CHG 146
Principal Hydrogeologist

MAP/ama

Enclosure

857 I dhont22.ama

Other Offices:
Mesa, AZ
Tucson, AZ
Dallas, TX

cc: Mr. Jeffrey Dhont, U.S. Environmental Protection Agency (3 copies)
Ms. Natasha Raykhman, CH2M Hill (2 copies)
Mr. Steve Acree, U.S. Environmental Protection Agency (1 copy)
Mr. Frank Gonzales, Department of Toxic Substances Control (1 copy)
Mr. Safouh Sayed, Department of Toxic Substances Control (1 copy)
Mr. Joe Kelly, Montrose Chemical Corporation of California (1 copy)
Mr. Paul Sundberg, Consultant to Montrose Chemical Corporation of California (1 copy)
Karl Lytz, Esq., Latham & Watkins (1 copy)
Mr. John Dudley, URS Corporation (1 copy)
Luke Mette, Esq., Stauffer Management Company, LLC (1 copy)
Mr. Lee Erickson, Stauffer Management Company, LLC (1 copy)
Paul Galvani, Esq., Ropes & Gray (without enclosure)

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ATTACHMENT 1

RESPONSE TO EPA COMMENTS ON
DRAFT PILOT EXTRACTION AND AQUIFER RESPONSE TEST WORKPLAN
DSGWRD 26-036
MONTROSE CHEMICAL SITE
LOS ANGELES COUNTY, CALIFORNIA
DUAL SITE GROUNDWATER OPERABLE UNIT
DATED JUNE 11, 2004

ATTACHMENT 1

RESPONSE TO EPA COMMENTS ON
DRAFT PILOT EXTRACTION AND AQUIFER RESPONSE TEST WORKPLAN
DSGWRD 26 - 036
MONTROSE CHEMICAL SITE
LOS ANGELES COUNTY, CALIFORNIA
DUAL SITE GROUNDWATER OPERABLE UNIT
DATED JUNE 11, 2004

Comments received August 23, 2004, in a letter from Mr. Jeffrey Dhont, U.S. Environmental Protection Agency, to Mr. Joe Kelly, Montrose Chemical Corporation.

General Comments

1. *The following issues pertain to permits, authorizations, access, and public safety.*

1. The Workplan states that discharge of treated water to the storm sewer will take place pursuant to an NPDES permit. However, this permit has not yet been obtained from the Regional Water Quality Control Board, and so its requirements are not established. Montrose should note that EPA will issue approval to the Workplan contingent on the approval of the NPDES permit process. EPA requests to receive from Montrose approved copies of all required NPDES permits prior to clearing this contingency.

RESPONSE: As noted in the Workplan, Section 4.0, "Treatment and Disposal of Water", Montrose will obtain a National Priority Pollutant Discharge Elimination System (NPDES) permit from the Los Angeles Regional Water Quality Control Board (RWQCB). Pursuant to the August 23, 2004, EPA request, a copy of the approved NPDES permit will be provided to EPA prior to starting the extraction tests. The NPDES permit application was submitted to the RWQCB on October 12, 2004. It is understood that EPA will issue only conditional approval of this Workplan until such time that a copy of the NPDES permit is provided to the EPA.

2. The Workplan does not mention permits or Agencies which are being contacted with respect to the use of hydrant water. Please identify these Agencies in the Workplan. Montrose should note that EPA will issue approval to the Workplan contingent on the approval of such applicable permitting processes. EPA requests to receive from Montrose approved copies of all required water or hydrant use permits prior to clearing this contingency.

RESPONSE: The Workplan has been updated to indicate that written notifications have been provided to EPA and to the RWQCB, Los Angeles Region, prior to initiation of the injection testing. These notifications were sent on October 5, 2004. Additionally, the Los Angeles Department of Water and Power (LADWP) and the Rancho-Dominguez District of the California Water Service (CWS) have been contacted regarding connection to fire hydrants which will be utilized as a potable water source. While this work must be coordinated with the RWQCB, the LADWP, and the CWS, no additional permitting is anticipated. In response to this request, EPA has been provided copies of correspondence regarding potable water use and injection during these testing activities.

3. The Workplan does not mention whether Montrose has contacted the RWQCB with respect to the hydrant water reinjection. Please clarify. While a permit is not required for this injection, the RWQCB should be contacted. EPA should also issue a notice to the RWQCB; EPA requests that Montrose provide EPA with any necessary information such that EPA can execute this coordination.

RESPONSE: As detailed in the previous response, written notifications have been provided to EPA and to the RWQCB in letters dated October 5, 2004.

4. The Workplan does not mention real property access agreements which may be necessary, nor their status. Montrose should identify in the plan any properties for which Montrose it believes will need real property access to execute this plan.

RESPONSE: Access agreements will be required for all but one of the proposed wells including all three of the Gage aquifer wells (G-IW-1, G-IW-2, and G-EW-1) and three of the Bellflower sand wells (BF-IW-1, GW-IW-2, and BF-EW-1). Bellflower extraction well BF-EW-2 is located in the County of Los Angeles right-of-way and will require an excavation permit prior to installation, but no access agreement is necessary. Montrose's legal counsel is actively pursuing access agreements from the appropriate parties, as detailed below.

- G-IW-1 and BF-IW-1: located west of the Montrose property
- BF-IW-2: located on the Alpine Village property
- G-IW-2: located on the Del Amo Waste Pit area
- G-EW-1 and BF-EW-1: located within the Los Angeles Department of Water and Power right-of-way

Sections 3.1.1 and 3.2.1 of the Workplan have been revised accordingly.

5. The Workplan lacks and should include a segment on potential public safety hazards and plan for mitigating these hazards, as well as general security of equipment and data during the test.

RESPONSE: A number of precautions will be taken to minimize the risk to both the public and also equipment operators. Traffic control measures including the use of flag men, road construction signage, and delineators will be utilized where traffic controls are required. Temporary fencing will be set around each drilling location and will be utilized, as needed, during potable water injection and groundwater recovery activities. The drill rig and other drilling equipment will be locked and secured each night prior to departing the site for the evening. Equipment utilized during the injection and recovery tests will be under 24-hour observation by equipment operators. Additionally, a security guard will remain at the drilling and test sites overnight. In addition, local law enforcement agencies will be asked to monitor the drilling and testing sites. The Workplan has been modified to include details regarding site security, health, and safety.

2. As was discussed at the July 1, 2004 modeling meeting, the data gap analysis performed by EPA as part of the initial modeling calibration efforts indicated that the remedial wellfield could fail to contain the toe of the chlorobenzene plume in the Bellflower Sand, if high permeability materials are present in this area. Consequently, EPA believes that assessing the hydraulic properties of the Bellflower Sand at the toe of the chlorobenzene plume should be an objective of the pilot test. This can be achieved by moving the location of one of the proposed extraction test wells in the Bellflower Sand to the toe of the plume. We understand that siting of the extraction test wells will depend on the groundwater quality at the proposed locations to ensure compliance with the NPDES permit for the disposal of extracted groundwater. We have held conversations with Montrose regarding the optimum location of the moved extraction well; we request that the modified Workplan be reflective of those conversations.

RESPONSE: Bellflower sand extraction well BF-EW-2 has been relocated to the toe of the chlorobenzene plume as discussed in the July 1, 2004 meeting. Section 3.1.1 and Figure 11 of the Workplan have been revised accordingly.

3. The location of the proposed eastern injection well (BF-IW-2) in the Bellflower Sand is not appropriate because it is adjacent to well SWL0040, which has 100,000 ppb of benzene. As was discussed at the July 1, 2004 modeling meeting, the alternate location for this well could be adjacent to well SWL0027. We have held conversations with Montrose regarding the optimum location of the moved extraction well; we request that the modified Workplan be reflective of those conversations.

RESPONSE: Bellflower sand injection well BF-IW-2 has been relocated adjacent to SWL0027. Section 3.2.1 and Figure 11 of the Workplan have been revised accordingly.

4. The location of the proposed western injection well (BF-IW-1) in the Bellflower Sand appears to be close to well BF-20, which has 2,100 ppb of chlorobenzene based on the 2004 baseline sampling results. As was discussed at the July 1, 2004 meeting, groundwater samples should be collected in the Bellflower Sand at this location from the CPT boring prior to finalizing the location of this injection well. If elevated chlorobenzene concentrations are detected in these samples, the location of this injection well should be moved. We recommend that alternate location(s) for this well be identified in the Workplan to avoid delays in implementing the pilot test in the case that the currently proposed location is within the chlorobenzene plume.

RESPONSE: Prior to constructing Bellflower sand injection well BF-IW-1, a groundwater sample will be obtained from the Bellflower sand by installing a temporary well in the planned exploratory borehole. The exploratory boring will be drilled using small diameter mud rotary drilling and coring equipment to obtain data for the injection well design. Prior to grouting the exploratory boring, the mud will be thinned and a temporary well casing and 0.020-inch slotted screen assembly will be installed within the Bellflower sand. The screen will be filter packed with #2-/16 Lonestar sand. A two-foot #60 silica sand grout filter will be placed over the filter pack using a tremie pipe. A ten-foot bentonite pellet annular seal will then be emplaced above the sand, opposite the overlying aquitard sediments and allowed to hydrate. The temporary well will be surged and pumped for several hours to remove the residual drilling mud. After field parameters have stabilized, a groundwater sample will be collected from a low flow tap on the submersible pump discharge for laboratory analysis. The sample will be analyzed on an expedited 24-hour turn around time for volatile organic compounds (VOCs) and para-chlorobenzene sulfonic acid (pCBSA) using EPA Methods 8260 and 314.0.

Following the collection of the grab sample, the temporary casing and screen will be pulled from the exploratory boring and the exploratory boring will be completed and geophysically logged. If the grab sample concentrations are approximately equal to or less than the Maximum Contaminant Levels (MCLs) for individual VOCs, the exploratory boring will be completed as an observation well cluster. The injection well will then be constructed near the observation well cluster as planned.

If the grab sample concentration exceeds the approximate MCL for any individual VOC, the exploratory boring will be abandoned by pressure grouting and the injection well and observation well cluster will then be constructed at one of two alternate locations as indicated in the revised Workplan.

5. As was discussed at several conference calls and the July 1, 2004 modeling meeting, the Bellflower Sand pilot extraction wells are also planned to be screened in the UBA (MBFB Sand). This is in anticipation of the wells being used not only in the pilot test but in the final wellfield. However, if the pilot extraction well is moved to the toe of the plume as suggested in General Comment #1, screening this well in the UBA may not be needed unless elevated concentrations of chlorobenzene are detected in the UBA and/or UBA and Bellflower Sand merge at this location. We agree that well BF-EW-1 (if not moved to the toe of the plume) should be screened in both units, because this well may be used for containing the chlorobenzene plume within the TI waiver zone in both UBA and Bellflower Sand. Therefore, the Workplan should state that the water level data *will be collected from the UBA monitoring wells during extraction from the pilot well(s) screened in both UBA and Bellflower Sand to assess whether these wells are sufficient to contain the plume in the UBA or whether separate UBA wells would be required. If well BF-EW-2 is left near the ARMCO site, it should also be cross-screened in both units because elevated concentrations were detected in the UBA at this location.*

> **RESPONSE:** Bellflower sand extraction well BF-EW-1 will not be moved to the toe of the plume. It is currently planned that Bellflower sand extraction well BF-EW-1 will be screened opposite all sand zones that may be encountered from the water table to the base of the Bellflower sand. Blank casing with individual annular bentonite seals will be placed opposite any significant aquitard sediments that effectively separate the coarser sand zones. This will allow for the potential use of packers in the future to hydraulically isolate or adjust the amount of groundwater extraction occurring from different zones should it become necessary to optimize the remedial pumping. Groundwater extraction from Bellflower sand extraction well BF-EW-1 will likely focus on what has been defined at the Del Amo site as the Bellflower C and B sands, as well as the upper Bellflower aquitard. The Workplan has been revised to indicate that water level data will be collected from upper Bellflower aquitard monitor wells during extraction from the pilot well BF-EW-1 to assess whether this well is sufficient to contain the plume in the upper Bellflower aquitard or whether additional upper Bellflower aquitard wells would be required.
>
> Bellflower sand extraction well BF-EW-2 has been relocated to the toe of the chlorobenzene plume as discussed in the July 1, 2004 meeting. The same approach will be used to select the blank casing and screen intervals for pilot extraction well BF-EW-2 as described above. It is not currently possible to predict whether a single merged sand or several sand intervals will be encountered at the proposed location. Based on the log of nearby Bellflower sand monitor well BF-17, a single coarse sand interval overlain by fine-grained aquitard sediments may be encountered. The Workplan has been revised to indicate that water level data will be collected from nearby upper Bellflower aquitard monitor wells located at the ARMCO Site to assess to what extent extraction from Bellflower sand extraction well BF-EW-2 hydraulically affects the upper Bellflower aquitard in the vicinity.

6. We request that locations of monitoring wells for the pilot test be selected based on the results of model simulations of the proposed pilot test, which were provided at the July 1, 2004 modeling meeting. These results indicate that the radius of influence of the test extraction wells is expected to extend over a large area in the MBFC Sand, which covers most of the chlorobenzene plume.

> **RESPONSE:** As requested, the locations of monitor wells have been modified based on the currently proposed locations of the extraction and injection wells and also based on model simulations. For each test well, the monitor wells are sorted into three categories: Tier 1, Tier 2, and Tier 3. The Tier 1 wells represent those wells which are nearest to the test well and therefore most likely to demonstrate observable influence. The Tier 2 and 3 wells are located at further distances from the test wells. If influence is seen at any of the outermost Tier 1 wells, monitoring will be extended to the Tier 2 wells. Monitoring will be further expanded to the Tier 3 wells, if influence is observed in the outermost Tier 2 wells. Regardless of the extent of influence observed during the test, water levels will be measured at all monitor wells prior to the test. After completion of the test and after completion of recovery, water levels will be measured in Tier 1 wells, and Tiers 2 and 3, if appropriate. Additional details regarding this protocol are included in Section 4.2.2 of Appendix A of the Workplan.

7. We request that at least three water level gauging rounds be performed on all existing monitoring wells including first round prior to the test, second round at the end of the test (i.e., prior to shutting down extraction), and third round at the end of recovery. This will provide the best information with which to triangulate the impact of extraction on the water level surface. The proper procedures should be included or cited in the Workplan for performing these water level gauging operations. The Workplan should include a clear description of the coordination of the timing of these efforts with the test procedure.

RESPONSE: Three rounds of water level measurements will be conducted. See response to Comment # 6 for details regarding which wells will be monitored for each portion of the test. All Tier 1, 2, and 3 wells will be measured before the test. After completion of the test and after completion of recovery, water levels will be measured in Tier 1 wells, and Tiers 2 and 3, if appropriate. The proposed water level monitoring schedule has been updated and is included in Table A-10 of Appendix A. This table details when manual water level measurements will be recorded and also provides details regarding the duration that transducers will remain in the wells for continuous logging of water level responses.

8. The Workplan should include contingencies for the test in the event that injection cannot be maintained (such as if there is plugging of well screens) and what steps will be taken to ascertain the cause of the plugging (one objective is to evaluate the potential for this plugging and its cause if observed). The Workplan should also include contingencies in the event that extraction must be shut down due to a problem with the treatment unit or other unforeseen lack of sewer capacity) such as to still obtain the greatest possible quality of data from the test.

RESPONSE: Workplan Sections 3.1.5, 3.2.5, 4.0, and 5.0 have been amended to include details regarding contingencies for interruption of the injection or extraction tests. This includes provisions both for troubleshooting, i.e., identification of the cause of the interruption, and for determining whether a test will be resumed or terminated. Injection well specific capacity will be closely monitored during each injection test for evidence of decreased well capacity. A small percentage of the injected water will be continuously directed to a 5-micron bypass filter apparatus during the injection test to assess the amount of suspended solids in the source water and correlate the rate of filter plugging with the change in well capacity. A field meter will be used to periodically monitor the residual chlorine concentration in the source water to evaluate the potential for inhibiting biological fouling in the well. The injection tubing will be designed to prevent cascading water or vacuum situations which could lead to air entrainment.

9. Please provide in a table in the Workplan a list of the data and information that will be obtained as a direct result of this test.

RESPONSE: Review of the document which was originally supplied suggests that this information was provided in the draft copy of the Workplan as Table A-10 in Appendix A. A copy of this table, which has been revised to include additional details, is provided in the Workplan.

Specific Comments

10. Section 3.1.2 - Extraction Well Design and Installation: The Workplan should clarify that the MBFC Sand extraction wells will be also screened in the MBFB Sand. The Workplan should also discuss whether both units are planned to be screened continuously, or a blank casing will be installed between the screens in the MBFB and MBFC Sand, if silts and clays are identified during drilling that separate these units.

RESPONSE: Bellflower sand extraction wells will be screened opposite each substantial sand zone encountered from the water table to the base of the Bellflower sand, including the MBFB sand and MBFC sand, if encountered. Blank casing with a corresponding bentonite annular seal will be placed opposite silty or clayey aquitard zones to allow hydraulic isolation of individual zones in the future, if warranted. If the MBFC sand and MBFB sand are merged and no aquitard sediments are encountered, then one continuous screen will be installed. For clarification, Section 3.1.2 of the Workplan has been revised.

11. Section 3.1.5 - Extraction Well Testing: Please clarify in the Workplan that the extraction/injections tests on the wells will be performed sequentially (not simultaneously)

RESPONSE: This section was revised to include additional details related to the completion of the pilot test. Revisions include clarification of the proposed schedule for testing activities, i.e., extraction and injection tests will be completed sequentially, not simultaneously.

12. Section 3.2.4 - Injection Well Sampling and Analysis: The Workplan should state that groundwater samples will be collected from the CPT boring prior to finalizing the location of the west injection well in the MBFC Sand.

RESPONSE: See response to Comment 4.

13. Appendix A; Section 4.2 - Water Level Measurements: Locations of monitoring wells for the extraction tests in the MBFC Sand should be revised based on the final locations of the extraction wells and results of model simulations presented at the July 1, 2004 modeling meeting. We also request that Montrose monitor wells G-12 and G-13 during the extraction test in the Gage Aquifer. We also request that at least three water level gauging rounds were performed on all existing monitoring wells (See general comment 7).

RESPONSE: Details regarding monitoring are included in previous responses; see responses to Comments numbers 6 and 7. Additionally, as requested, monitor wells G-12 and G-13 will be included as Tier 1 monitor wells during the extraction test in the Gage aquifer.

14. Appendix A; Section 6.1.3.4 - Bellflower Sand and Gage Aquifer Extraction and Injection Wells: The Workplan should provide the rationale for the construction of the pilot injection and extraction wells. For example, it should be clarified why PVC was selected for well casings and screens as supposed to steel. The use of PVC may impact the longevity and complicate maintenance of these wells, which are supposed to serve as actual remediation wells and will need to last for over 50 years. The use of steel casings and screens, on the other hand, would allow more effective redevelopment of these wells (especially injection wells) using wire-brush and other methods (e.g., chemicals) that can not be used for PVC casings and screens. In addition, Montrose should evaluate the use of stainless steel wire rap screens for both inside and outside portions of the screen or shutter (full flow) screens for injection wells as opposed to perforated PVC proposed by the Workplan. These screens provide greater open area and allow more effective redevelopment, which is an important issue for an injection well that will be operated for more than 50 years. The basis for a 12-inch diameter, well depths, and screened intervals should also be presented in the Workplan.

RESPONSE: The Workplan has been revised to indicate that stainless steel casing and wire wrap screen will be used for both injection and extraction wells. As detailed in the revised Workplan, the 12-inch well diameter was selected to accommodate all down-hole monitoring equipment and also the largest diameter submersible pump.

15. Appendix A; Section 6.3 - Pilot Extraction and Aquifer Response Testing: Equipment and Instrumentation section should describe the submersible pump which will be used for the test (the pump description could be moved from Section 4 - Treatment and Disposal of Water).

RESPONSE: This section has been amended to include specifications for the submersible groundwater extraction pump.

HARGIS + ASSOCIATES, INC.
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Mission City Corporate Center
2365 Northside Drive, Suite C-100
San Diego, CA 92108
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VIA FEDERAL EXPRESS

Mr. Jeffrey Dhont
Superfund Project Manager
U.S. ENVIRONMENTAL PROTECTION AGENCY
75 Hawthorn Street (SFD-7-1)
San Francisco, CA 94105-3901

Re: Submittal of Draft Workplan for Pilot Extraction and Aquifer Response Test, Montrose Site, Torrance, California

Dear Mr. Dhont:

Enclosed are three copies of the draft report titled:

Draft
Workplan for Pilot Extraction
And Aquifer Response Test
Montrose Site
Torrance, California
DSGWRD 26-**036**

This report is being submitted to the U. S. Environmental Protection Agency (EPA) in accordance with the statement of work for the Unilateral Administrative Order for Initial Groundwater Remedial Design Activities.

If you have any questions or comments, please contact us.

Sincerely,

HARGIS + ASSOCIATES, INC.

Michael A. Palmer, RG 5915, CHG 146
Principal Hydrogeologist

David R. Hargis, PhD, RG 3824

MAP/ama

Enclosure

cc: Mr. Jeffrey Dhont, U.S. Environmental Protection Agency (3 copies)
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Paul Galvani, Esq., Ropes & Gray (without enclosure)

857 I dhont12.ama

Other Offices:
Mesa, AZ
Tucson, AZ
Dallas, TX

PILOT EXTRACTION AND AQUIFER RESPONSE TEST WORKPLAN
MONTROSE SITE
TORRANCE, CALIFORNIA
DSGWRD 26 – **036**

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TABLES

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APPENDICES

ACRONYMS AND ABBREVIATIONS

BHC	Hexachlorocyclohexane
bls	Below land surface
DDT	Dichlorodiphenyltrichloroethane
DPW	Los Angeles Department of Water and Power
DQOs	Data quality objectives
EPA	U.S. Environmental Projection Agency
FSP	Field Sampling Plan
gpm	Gallons per minute
H+A	Hargis + Associates, Inc.
JGWFS	Joint Groundwater Feasibility Study
MBFB	Middle Bellflower B sand
MBFC	Middle Bellflower C sand
Montrose	Montrose Chemical Corporation of California
msl	Mean sea level
NPDES	National Pollution Discharge Elimination System
pCBSA	para-Chlorobenzene Sulfonic Acid
Pilot Testing Program	Pilot Test and Aquifer Response Program
Property	Area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles (near Torrance), California
psig	Pounds per square inch gage
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/quality control
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
Site	Montrose Chemical Corporation of California Site
SOPs	Standard operating procedures
SOW	Statement of Work
UAO	Unilateral Administrative Order

ACRONYMS AND ABBREVIATIONS (continued)

UBF	Upper Bellflower
ug/l	Micrograms per liter
VOCs	Volatile organic compounds
Workplan	Pilot Extraction and Aquifer Response Test Workplan

DRAFT
PILOT EXTRACTION AND AQUIFER RESPONSE TEST WORKPLAN
MONTROSE SITE
TORRANCE, CALIFORNIA
DSGWRD 26 – **036**

1.0 INTRODUCTION

This Pilot Extraction and Aquifer Response Test Workplan (Workplan) has been prepared for Montrose Chemical Corporation of California (Montrose) in accordance with the requirements outlined in Section 4 of the Unilateral Administrative Order (UAO) Statement of Work (SOW), First Amendment (U.S. Environmental Protection Agency [EPA], 2004). The Pilot Extraction and Aquifer Response Test program (Pilot Testing Program) is being conducted to provide additional data needed for the design of the Montrose-Del Amo Joint Groundwater Remedy as specified in the Record of Decision (ROD) (EPA, 1999). The Montrose Site (Site) and Del Amo site are independent Superfund sites with separate histories, but are considered a joint site by EPA with respect to the groundwater operable unit and associated remedial design investigations.

EPA is currently conducting a comprehensive groundwater modeling program leading to the development of the final design for the remediation wellfield. A significant component of the modeling effort will be focused on conducting iterative simulations to assess and account for the uncertainties inherent in the model with the goal of achieving a wellfield design which will meet the ROD cleanup criteria. Uncertainties in the model and the subsequent remedial wellfield design can be minimized by obtaining field performance data through a program of phased installation and testing of groups of full scale extraction and injection wells. This approach will enable the modeling to move forward and reduce the number of iterative model simulations.

This Workplan describes the proposed location, design, and construction of three pilot extraction wells, four pilot injection wells, and three observation wells. The pilot extraction and injection wells will be designed and constructed in a manner that will allow them to be incorporated into the final remediation wellfield. The Workplan also describes the proposed extraction and injection testing procedures to be used.

The field sampling plan (FSP) that describes the objectives, rationale, methods, field equipment, standard operating procedures (SOPs), and additional details for the pilot extraction and aquifer response testing has been included with this Workplan as Appendix A. The FSP was developed in accordance with the EPA guidance document "Preparation of a U.S. EPA Region 9 Field Sample Plan for EPA-Lead Superfund Projects", Document Control No. 9QA-06-93" (EPA, 1994). The quality assurance project plan (QAPP) that describes the data quality objectives (DQOs) and quality assurance/quality control (QA/QC) SOPs that will be implemented during field and laboratory activities for the pilot extraction and aquifer response testing program has been included with this Workplan as Appendix B. The QAPP was developed in accordance with the EPA guidance document "EPA Guidance for Quality Assurance Project Plans, Document Control No. EPA QA/G-5" (EPA, 1998a).

Due to the comprehensive and extensive nature of supporting documentation, information contained in the Montrose Remedial Investigation (RI) Report is frequently incorporated by reference in this Workplan and has not been duplicated herein (EPA, 1998b).

1.1 PURPOSE

The purpose of the Pilot Testing Program is to provide data on full scale extraction and injection well performance and the resulting aquifer and aquitard response, which will reduce the uncertainties involved in modeling and lead to a more robust and cost effective remedial design. Information regarding the specific capacity of full scale extraction and injection wells is needed to determine the number of wells that may be required to meet remedial objectives, and therefore is critical to the wellfield design. In addition, data will be obtained during the pilot testing program from surrounding monitor wells completed in the extraction and injection zones, as well as the adjacent aquitards. This monitoring data, once incorporated into the model, will reduce the uncertainty in the model results, provide a more reliable wellfield design, and eliminate unnecessary conservatism and costs. In addition, these wells will define the standards by which other extraction and injection wells will be installed as part of the final remedial program implementation.

To date, estimates of aquifer hydraulic parameters have been based primarily on short-term aquifer and slug tests conducted in small diameter monitor wells by the Montrose and Del Amo respondents. This Pilot Testing program will provide more reliable estimates of aquifer and aquitard hydraulic properties and extraction/injection well performance based on longer-term pumping of full scale pilot extraction and injection wells.

1.2 DEFINITION OF TERMS

To facilitate the discussion within this document, several defined terms are used as described below. For clarity of discussion only, this report will refer to the "Property" as the area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles, near Torrance, California (Figure 1). The term "central process area" refers to an approximate two-acre portion of the Property where most of the manufacturing operations were historically performed.

The term dichlorodiphenyltrichloroethane (DDT) or total DDT, will be used to refer to the sum of the isomers and metabolites of DDT. The term hexachlorocyclohexane (BHC) or total BHC, will be used to refer to the sum of the isomers of BHC.

1.3 OBJECTIVES

In accordance with the UAO SOW Section 4, the objectives of the Pilot Testing Program are to:

- Obtain data regarding the response of the hydrostratigraphic system to the stress of pumping and injection on a scale approaching that to be used in the full scale production wells.

- Obtain more reliable estimates of aquifer transmissivity, hydraulic conductivity, storativity, and aquitard leakance that can be used to improve the reliability of the groundwater model and wellfield simulations.

- Obtain data regarding the radius of influence and capture zones likely to be achieved by full scale extraction wells.

- Obtain information about injection rates for full scale injection wells and evaluate injection well plugging issues.

- Provide information needed to develop specifications for extraction and injection wells, treatment system, piping and control systems, and facilitate the design of these physical systems upon completion of the modeling and wellfield optimization.

1.4 SCOPE

Pursuant to Section 4.0 of the UAO SOW, the Workplan shall include the following major components:

- The specific objectives to be met by the pilot testing with the data needs clearly identified;

- Clear identification of the data and the interpretation that will be provided after the test;

- Proposed pilot extraction and injection well construction details; drilling methods and equipment; construction materials; borehole, casing and annular seal materials; depths of screened and blank casing intervals; and well development procedures;

- Proposed nested piezometer construction details; drilling methods; construction materials; borehole, casing and annular seal materials; depths of screened and blank casing intervals; and well development procedures;

- Proposed pilot testing procedures and equipment including: pump, transducers, and other dedicated or temporary downhole equipment;

- Details regarding the treatment and/or disposal of development water, drilling fluids, and other potentially contaminated media;

- Groundwater sampling procedures and chemical and physical parameters to be included in the sample analysis of the new wells, pending incorporation into the overall monitoring plan;

- A diagram with a description of any treatment and disposal/injection systems to be tested, along with descriptions of test equipment, procedures, and measurements of performance;

- A discussion of the treatment process;

- A description of pilot system installation and startup;

- A discussion of pilot system operation and maintenance procedures and description of any ancillary facilities required to conduct the testing;

- Identification of the data type and frequency that will be collected during the pilot testing;

- Discussion of permitting requirements;

- Identification of the methodology and procedures for data collection during pilot testing and the DQOs, which define the statistical accuracy, precision, and representative ness of the data;

- A discussion of the quality control samples needed to meet the data quality objectives;

- Pollution control planning which outlines the process, procedures, and safeguards that shall be used to ensure contaminants are not improperly released during the pilot test;

- Investigation derived waste management planning which includes procedures for managing wastes from conducting the pilot testing, including procedures for transporting these wastes off-site for purpose of storage, treatment and/or disposal. The Workplan will provide details on discharge or disposal requirements for treated water.

These items are addressed in the Workplan, FSP (Appendix A) and in the QAPP (Appendix B).

2.0 BACKGROUND

Background information including site location and description, site history, stratigraphy, hydrogeology, and previous investigations is provided in the subsequent sections.

2.1 SITE LOCATION AND DESCRIPTION

The Montrose Property occupies approximately 13 acres in the City of Los Angeles near Torrance, California (Figure 1). The Property is bounded by the Union Pacific Railroad right-of-way and Normandie Avenue to the east; Jones Chemical Company and a right-of-way owned by the Los Angeles Department of Water and Power to the south; former Boeing Realty Corporation to the north; and Frito-Lay to the west. The Montrose property is generally level. Elevations range from 40 feet above mean sea level (msl) to 45 feet msl. The surrounding area consists of mixed residential, commercial, and industrial facilities. The Property is accessible by city streets in the area and Interstates 405 and 110. Los Angeles International Airport is located approximately 10 miles from the Property.

The former Del Amo Synthetic Rubber plant and property, operated between 1942 and 1972. The Del Amo plant and property lies in an area roughly bounded by Normandie Avenue on the west, Interstate 110 on the east, 190th Street on the north and Del Amo Boulevard on the south (Figure 2).

2.2 SITE HISTORY

Montrose manufactured DDT at the Site from 1947 to 1982. The facility was closed in 1982 and the Site was subsequently cleared and capped with asphalt. Previous investigations addressing the potential for contamination at the Site included on- and off-property sampling of soil, groundwater, sediment, and surface water. The investigations were performed by the EPA, its contractors, the California Department of Health Services, the Regional Water Quality Control

Board, and Montrose's consultants. The RI Report provides a detailed summary of the Site history (EPA, 1998b).

2.3 STRATIGRAPHY

The stratigraphy of the Site was defined using published regional geologic information and by site-specific data collected from monitor wells and borings drilled during numerous Site investigations. While a brief summary of the stratigraphy is provided below to provide context to this Workplan, the reader is referred to the RI Report for additional detailed information (EPA, 1998b).

The stratigraphy of the Site, starting at land surface, consists of fill material, the Playa deposits, the Palos Verdes sand, the Bellflower aquitard, the Gage aquifer, an unnamed aquitard, and the Lynwood aquifer (EPA, 1998b). Three geologic units comprise the vadose zone encountered at the Site: recent Playa deposits, late Pleistocene marine deposits referred to as the Palos Verdes sand, and the upper portion of the Pleistocene Bellflower aquitard.

Fill material consisting of moderately to highly plastic dark brown clay with occasional brick and concrete debris is generally encountered from land surface to approximately 4 feet below land surface (bls). On the pads, fill material is generally encountered from land surface to approximately 8 feet bls. In the vicinity of the former water recycling pond in the CPA, fill material is approximately 20 feet thick. The Playa deposits, consisting of olive-brown silty sand, sandy silt, and silt are generally encountered beneath the fill material to a depth of approximately 22 feet bls. The Palos Verdes sand, consisting of a fine-grained, light yellowish brown to light olive-brown, well sorted sand, is generally encountered to a depth of approximately 44 feet bls. A well-cemented fossiliferous sand is encountered at the base of the Palos Verdes sand. This cemented fossiliferous sand is thickest in the western portions of the Property, and appears to dip slightly and pinch out toward the east. The thickness of this unit in the western portion of the Property was approximately 8 feet and was approximately 2 feet in the eastern portion of the Property.

The Bellflower aquitard immediately underlies the Palos Verdes sand. Three lithologically distinct subunits of the Bellflower aquitard are encountered at the Site: the upper Bellflower aquitard, the Bellflower sand, and the lower Bellflower aquitard. The first groundwater beneath the Site is encountered within the upper Bellflower aquitard at a depth of approximately 65 feet bls. The upper Bellflower aquitard consists of fine-grained sand, silty sand, silt and clay. These sediments are interbedded, discontinuous, and vary in thickness. The upper Bellflower aquitard is encountered to a depth of approximately 100 feet bls. The Bellflower sand underlies the upper Bellflower aquitard. The Bellflower sand is a fine- to medium-grained sand. The Bellflower sand is encountered to a depth of approximately 130 feet bls. The lower Bellflower aquitard, consisting of a brown silty sand and silt, is encountered beneath the Bellflower sand to a depth of approximately 140 feet bls.

At the nearby Del Amo Site, the upper Bellflower aquitard has been further subdivided into the following units: the upper Bellflower or UBF, the middle Bellflower B Sand or MBFB, and the middle Bellflower C Sand MBFC. The water table occurs in the UBF at most of the Del Amo Site, but it occurs in the MBFB sand at the Montrose Site. The MBFC correlates with the Bellflower sand

The Gage aquifer, consisting of fine-grained sand, is encountered beneath the lower Bellflower aquitard to a depth of approximately 220 feet bls. An unnamed aquitard underlying the Gage aquifer has been informally named the Gage-Lynwood aquitard. It consists of silt, sandy silt, and/or clayey silt interbedded with fine-grained silty sand and appears to be laterally continuous across the Site.

The upper 20 feet of the Lynwood aquifer consists of dark gray fine- to medium-grained sand. This sand is underlain by as much as 8 feet of dark gray silt or clay of varying plasticity. Approximately 10 to 30 feet of gray, well-graded sand, gravelly sand, and sandy gravel with some silty sand interbeds underlie the top 20 to 30 feet of the Lynwood aquifer. The Lynwood aquifer occurs approximately between 270 to 305 feet bls across the Site. The thickness of the Lynwood aquifer, based on borings drilled at the Site, varies from 33 feet to greater than 108 feet.

An unnamed aquitard, approximately 205 feet thick, separates the Lynwood aquifer and the underlying Silverado aquifer beneath and east of the Site. The Silverado aquifer consists of fine- to coarse-grained blue-gray sands and gravels with discontinuous layers of silt and clay. These deposits reportedly attain a maximum thickness of about 500 feet.

2.4 HYDROGEOLOGY

Most of the recharge to the West Coast Basin aquifers occurs at the West Coast Barrier Project and the Dominguez Gap Barrier Project. Fresh water is injected into a line of injection wells that parallels the coastline. The injected water forms a freshwater pressure ridge that acts as a barrier to protect basin groundwater from saltwater intrusion. A slight seaward flow of groundwater is maintained between the barrier and the ocean that prevents intrusion of seawater. Most of the injected water flows from the barrier toward the interior of the basin.

The regional direction of groundwater flow within the West Coast Basin is controlled by the injection barriers and pumping centers. The predominant flow direction in the Silverado aquifer is to the east from the West Coast Basin Barrier Project to pumping centers located in Gardena, Wilmington, and Carson.

In general, the groundwater flow direction in the upper Bellflower aquitard during January 2004 was to the south and southeast, but varied locally (Figure 3). The regional direction of groundwater flow in the upper Bellflower aquitard has been about the same since 1988 (Hargis + Associates, Inc., [H+A], 2004b).

In general, the groundwater flow direction in the Bellflower sand in the vicinity of the Site during January 2004 was to the southeast (Figure 4). The regional direction of groundwater flow in the Bellflower sand has been about the same since 1987 (H+A, 2004b).

In general, the groundwater flow direction in the Gage aquifer during January 2004 was to the southeast (Figure 5). The regional direction of groundwater flow in the Gage aquifer has been about the same since 1987 (H+A, 2004b).

In general, the groundwater flow direction in the Lynwood aquifer during January 2004 was to the east (Figure 6). The direction of groundwater flow in January 2004 was about the same as the direction of groundwater flow observed in 2002 (H+A, 2004b). In 1995, groundwater flow in this unit was to the southeast.

2.5 PREVIOUS INVESTIGATIONS

The following summarizes the previous investigations that have been conducted at the Site from 1985 through January 2004.

Montrose has conducted groundwater monitoring since 1985. A total of 97 monitor and extraction/test/injection wells were originally constructed as part of RI activities conducted by Montrose to evaluate the nature and extent of Montrose-related compounds in groundwater. A number of monitor wells have been destroyed by different entities during construction, grading, or paving activities on surrounding properties. Presently there are over 85 monitor wells and six extraction/test/injection wells at the Site (Figure 2).

Montrose monitor wells are completed in each of the following four hydrostratigraphic zones, which are identified in order of increasing depth bls:

- Upper Bellflower aquitard
- Bellflower sand
- Gage aquifer
- Lynwood aquifer.

Detailed discussion and conclusions regarding hydrostratigraphic interpretations, directions of groundwater flow, and the nature and extent of contamination in each of these hydrostratigraphic zones are provided in the RI Report (EPA, 1998b). The RI Report also describes the historical background; history of response; assessment objectives; assessment results; laboratory analyses; quality assurance; fate and transport of compounds of concern; and other pertinent information, such as aquifer test results, well construction, and well development specifications.

A baseline groundwater sampling round was conducted in January 2004. Prior to beginning groundwater sampling, water level measurements were obtained from 88 accessible Montrose monitor wells and one Del Amo well (Figures 3 through 6). A total of 72 monitor wells were sampled during the baseline sampling event consisting of 20 upper Bellflower aquitard monitor wells, 29 Bellflower sand monitor wells, 18 Gage aquifer monitor wells, and 5 Lynwood aquifer monitor wells. All groundwater samples were analyzed for volatile organic compounds (VOCs) using EPA Method 8260B, and for para-Chlorobenzene Sulfonic Acid (pCBSA) using modified EPA Method 314. Additionally, groundwater samples from selected wells were analyzed for DDT, hexachlorocyclohexane, and other organochlorine pesticides using EPA Method 8081A and for parameters used to evaluate the potential for plugging injection wells during remedial action and in support of future engineering studies. Sampling methods and analytical results are provided in the Baseline Groundwater Sampling Results Report (H+A, 2004b).

2.6 NATURE AND EXTENT OF CHLOROBENZENE IN GROUNDWATER

The following sections outline the nature and extent of chlorobenzene in groundwater in each of the hydrostratigraphic units based on data collected in January 2004. An understanding of the extent of the chlorobenzene plumes is necessary in order to evaluate the locations of proposed extraction and injection wells.

2.6.1 Upper Bellflower Aquitard

Chlorobenzene was detected in 13 of the 20 upper Bellflower aquitard monitor wells sampled during the baseline sampling round (Table 1; Figure 7). Concentration of chlorobenzene detected in groundwater from the upper Bellflower aquitard ranged from 3.3 micrograms per liter (ug/l) in monitor well MW-19 to 130,000 ug/l in monitor well MW-01. A comparison of previous chlorobenzene data with results from the baseline sampling round indicates that chlorobenzene concentrations have increased in 5 monitor wells, decreased in 8 monitor wells, and remained relatively unchanged in 7 monitor wells since the previous groundwater sampling round. Chlorobenzene concentrations in samples collected from monitor wells MW-01, MW-04, and MW-13 exceed the historical high concentrations for these wells. Seven of the eight monitor wells where decreases in chlorobenzene concentrations occurred were below the historic range of chlorobenzene concentrations at these wells. Chlorobenzene results for two of these seven monitor wells were below the method detection limit of 2 ug/l (Table 1).

The chlorobenzene plume in the upper Bellflower aquitard originates at the CPA and extends downgradient a distance of approximately 1,500 feet (Figure 7). The extent of the chlorobenzene plume in the upper Bellflower aquitard is similar to that observed in 2002 and 1995 with the following exceptions:

- Chlorobenzene was detected at a concentration of 5.1 ug/l in monitor well MW-08, located northeast of the Property, in 2004 (Figure 7). In 1995, chlorobenzene was not detected in this well. This well was not sampled in 2002. Previously, the concentration of chlorobenzene in this well ranged from less than the detection limit to 5.0 ug/l (Table 1). The 1 ug/l concentration contour has been extended to the northeast in the vicinity of this monitor well (Figure 7;).

- Chlorobenzene was not detected in monitor well MW-17, located southeast of Jones Chemical, in 2004 (Figure 7). Chlorobenzene at this monitor well has been historically detected at concentrations ranging from 2 ug/l to 7.5 ug/l (Table 1). The 1 ug/l contour in the vicinity of this monitor well has contracted (Figure 7).

2.6.2 Bellflower Sand

Chlorobenzene was detected in 23 of the 29 Bellflower sand monitor wells sampled during the baseline sampling round (Table 1; Figure 8). Concentrations of chlorobenzene detected in groundwater from the Bellflower sand ranged from 3.6 ug/l in monitor well BF-26 to 47,000 ug/l in monitor well BF-02. A comparison of previous chlorobenzene data with results from the baseline sampling round indicates that chlorobenzene concentrations have increased in 12 monitor wells, decreased in 11 monitor wells, and remained relatively unchanged in 6 monitor wells. Chlorobenzene concentrations in samples collected at monitor wells BF-02, BF-10, BF-11, BF-16, BF-17, BF-20, and BF-24 exceed the historical high concentrations for these wells (Table 1). Eight of the eighteen monitor wells where decreases in chlorobenzene concentrations occurred were below the historical low concentrations at these monitor wells.

The lateral extent of chlorobenzene in the Bellflower sand is much greater than other hydrogeologic units. The chlorobenzene plume in the Bellflower sand originates at the CPA and extends downgradient a distance of approximately 6,500 feet (Figure 8). The lateral extent of the chlorobenzene plume in the Bellflower sand is similar to that observed in 2002 and 1995, with the exception that chlorobenzene was not detected in monitor well BF-32A, located southwest of the Property, in 2004 (Figure 8). Chlorobenzene at this monitor well had been detected previously at concentrations as great as 180 ug/l (Table 1). The 1 ug/l contour in this area has contracted (Figure 8).

2.6.3 Gage Aquifer

Chlorobenzene was detected in 14 of the 16 Gage aquifer monitor wells sampled during the baseline sampling round (Table 1; Figure 9). Concentrations of chlorobenzene detected in groundwater from the Gage aquifer ranged from 13 ug/l in monitor well G-15 to 17,000 ug/l in monitor well G-02. A comparison of previous chlorobenzene data with results from the baseline sampling round indicates that chlorobenzene concentrations have increased in 9 monitor wells, decreased in 5 monitor wells, and remained relatively unchanged in 2 monitor wells. Chlorobenzene concentrations in samples collected at monitor wells G-01, G-08, G-09, G-11, G-13, G-17, and G-19 exceed the historical high concentrations for these wells (Table 1).

Lower Gage aquifer monitor wells LG-01 and LG-02 were sampled during the baseline event. Concentrations of chlorobenzene in samples collected in these wells were 9.5 ug/l and 120 ug/l, respectively. These concentrations are below the historical high concentrations previously detected at these wells (Table 1; Figure 9).

The extent of the chlorobenzene plume, as defined by the 1 ug/l contour, in the Gage aquifer is similar to that observed in 2002 and 1995 (Figure 9)(H+A, 2004b). The chlorobenzene plume in the Gage aquifer extends from sources in the CPA to the southeast for a distance of approximately 4,000 feet.

2.6.4 Lynwood Aquifer

Chlorobenzene was detected in 2 of the 5 Lynwood aquifer monitor wells sampled during the baseline sampling round (Table 1; Figure 10). Concentrations of chlorobenzene detected in groundwater from the Lynwood aquifer were 8.4 ug/l in monitor well LW-02 and 64 ug/l in monitor well LW-01 (Table 1). Chlorobenzene has not been previously detected at monitor well LW-02. The concentration of chlorobenzene detected in monitor well LW-01 is within the historical concentration range for this well.

Chlorobenzene isoconcentration contours indicate that the lateral limit of chlorobenzene, as defined by the 1 ug/l concentration contour, in the Lynwood aquifer is defined (Figure 10).

2.7 JOINT GROUNDWATER MODELING

The original model of the Site was developed in support of the Joint Groundwater Feasibility Study (JGWFS) to perform feasibility-study level analysis of the remedial alternatives. MODFLOW, a three-dimensional finite difference model, was used to simulate groundwater flow at the Joint Site. MODFLOW was linked to the transport model MT3D for the simulations of contaminant transport. The model domain was a rectangular area centered on, and extending beyond, the Joint Site, incorporating known and potential sources of contamination, which lie in the vicinity of the Joint Site. The model grid consisted of 5,229 rectangular cells of 200 by 200-foot size in the primary area of interest, and 200 by 400-foot cells in the peripheral areas. Vertically, the model was divided into 13 layers of variable thickness to represent eight affected hydrostratigraphic units discussed in the JGWFS. Hydrogeologic properties were assigned to the model based on the results of remedial investigations performed at the Montrose and Del Amo Sites. EPA selected the 700 gallons per minute (gpm) scenario as the preferred alternative (EPA, 1999). This alternative includes extraction wells located along the axis of the Bellflower sand and Gage aquifer chlorobenzene plume, and one extraction well in the Lynwood aquifer. This alternative also included injection wells located at the periphery of the Bellflower sand and Gage aquifer chlorobenzene plumes in order to dispose of the treated water and control the chlorobenzene plume.

Although the JGWFS model was based on the results of the extensive remedial investigations conducted at the Site, and was sufficient for the feasibility-study-level analysis, it was concluded that additional modeling was required for the Remedial Design (RD) (CH2M Hill, 2003). There are a number of uncertainties associated with the JGWFS model input parameters. These uncertainties result from the inherent complexity of the hydrogeologic conditions beneath the Site and the absence of constraints associated with the model boundaries. While these uncertainties are not uncommon when modeling complex physical systems such as that found at the Site, and are acceptable for the comparative evaluation of remedial scenarios performed during the JGWFS, they need to be re-evaluated, quantified to the extent possible, and reduced during the RD to increase the accuracy of modeling predictions of the performance of the remedial wellfield. This can be achieved through the use of an improved and systematic calibration process utilizing automatic calibration software, which was not available at the time of the original calibration of the JGWFS model, and the collection of additional data in the field.

The model developed for the RD is based on the existing JGWFS model, which will be enhanced using additional data collected during the RD, and calibrated using the automatic calibration software package PEST (Doherty, 2002; Doherty and Johnston, 2003). PEST is a parameter estimation program that should produce a significant improvement in the calibration of both flow and transport simulations. PEST will also be used to help assess quantitatively the uncertainties in model predictions regarding the performance of the remedial wellfield, and its ability to satisfy the performance criteria specified in the ROD.

3.0 DATA GAP ANALYSIS AND RECOMMENDED WORK

Available data from the Site do not provide adequate estimates of horizontal and vertical hydraulic conductivity and storativity within the modeling domain. The EPA has prepared a Draft Modeling Work Plan outlining a comprehensive groundwater modeling program leading to the development of the final design for the remediation wellfield (CH2M Hill, 2003). A significant component of the modeling effort will be focused on conducting iterative simulations to assess and account for the uncertainties inherent in the model in order that the final wellfield design will meet the ROD cleanup criteria. Model uncertainties will be addressed by obtaining field data through a program of phased installation and testing of groups of full scale extraction and injection wells in combination with a focused modeling program. The extraction and injection wells will be designed and constructed in a manner that will allow them to be incorporated into the final remediation wellfield.

This approach will provide data regarding extraction and injection well performance as well as data regarding aquifer and aquitard response, which can be used to further refine and validate the model. Extraction and injection well specific capacity and yield have a direct bearing on the number of wells that may be required to meet remedial objectives, and therefore this information is critical to the wellfield design. In addition, data will be obtained during the Pilot Testing program from surrounding monitor wells completed in the extraction and injection zones and the adjacent aquitards. This monitoring data will be incorporated into the model to reduce the uncertainty in the model results, resulting in a more reliable wellfield design and eliminating unnecessary conservatism and cost.

The following identifies the proposed extraction and injection well locations and provides a brief overview of well construction and sampling. Details regarding the extraction and injection testing are provided. Information regarding groundwater treatment and disposal required for the extraction testing is described in Section 4.0. Information regarding water filtration and injection testing is described in Section 5.0. Information regarding investigation derived waste handling and disposal is provided in the FSP (Appendix B).

3.1 EXTRACTION WELLS

3.1.1 Proposed Extraction Well Locations

Based on the configuration of the chlorobenzene plume as determined by the recent baseline sampling results, analysis of available short-term aquifer test data, and the results of the feasibility study modeling, it is possible to select extraction well locations, two for the Bellflower sand and one for the Gage aquifer, that will be compatible with the final wellfield design. The plume distribution in the Bellflower sand and the Gage aquifer has been well characterized so there is little risk that the initial wells will be inconsistent with the final remedial wellfield.

Previous modeling has shown that plume reduction occurs more rapidly when extraction occurs along the axis of the plume where concentrations are highest. As the plume contracts and the concentrations of contaminants are reduced below in situ groundwater standards, some wells will be taken out of service. The groundwater extraction from wells that are shut down will need to be transferred to other wells in order to maintain the minimum 700 gpm flowrate specified in the ROD. It is not currently known whether increasing the pumping rate of the original extraction wells can make up the lost extraction. This uncertainty will also be addressed by the proposed testing program by pumping the extraction wells at a relatively high rate. These data can be used to assess the feasibility of maintaining the ROD-mandated extraction rate as the remedy progresses.

The central plume area lies largely under residential neighborhoods and suitable well locations are limited. Extraction wells will have to be located in city streets or along utility corridors. Because of these constraints, as well as those imposed by the plume distribution, extraction well location alternatives useable for the final wellfield design are so limited that extraction well locations can be identified with a high level of certainty. The proposed locations for the extraction wells are shown on Figures 11 and 12. The proposed extraction wells BF-EW-1, BF-EW-2, and G-EW-1 are located along the axis of the Bellflower sand and Gage aquifer plumes where chlorobenzene concentrations tend to be high.

Extraction wells BF-EW-1 and G-EW-1 are proposed to be installed on property the Los Angeles Department of Water and Power right-of-way. Extraction well BF-EW-2 is proposed to be installed in a County of Los Angeles street. Montrose has begun the access process.

3.1.2 Extraction Well Design And Installation

A small diameter exploratory boring will first be advanced at each extraction well location to obtain core samples for physical and chemical testing, and to provide the lithologic data required to ensure a proper well design. Grain size analyses will be conducted to evaluate proposed well screen slot sizes. Compressibility and permeability tests will be conducted on aquitard samples to aid in assessing vertical hydraulic conductivity. Aquitard samples will also be analyzed for chlorobenzene, pCBSA, and total organic carbon to allow assessment of aquitard mass and transport properties. Upon completion, the exploratory boring will be reamed and utilized for the installation of the observation wells (Section 3.1.3).

The construction and design of the extraction wells will be typical of full scale water production wells. Data from the short-term aquifer tests conducted on monitor wells during the RI indicate that extraction well capacities in excess of 100 to 300 gpm may be achievable. The extraction wells will be drilled using the conventional mud-rotary drilling method. A conductor casing will first be installed and cemented in place from ground surface to near the base of the aquitard overlying the target aquifer zone. The borehole will then be advanced to the total depth. The well casing diameter will be sufficiently large to accommodate the largest pump that may be required based on the maximum anticipated well yield and downhole monitoring equipment that may be required. The well screen will consist of 12-inch diameter 316L stainless steel wire wrap screen and the screen interval will be selected to fully penetrate the unit being tested. Bellflower sand extraction wells will be screened opposite each substantial sand zone encountered from the water table to the base of the Bellflower sand, including the MBFB sand and MBFC sand, if encountered. Blank 316L stainless steel casing with a corresponding bentonite annular seal will be placed opposite silty or clayey aquitard zones to allow hydraulic isolation of individual zones in the future, if warranted. If the MBFC sand and MBFB sand are merged and no aquitard sediments are encountered then the one continuous screen will be installed. The extraction wells will be developed using a combination of bailing, swabbing, jetting, and/or pumping.

SOPs for the drilling, construction, and development of the extraction wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003). Well design, drilling, lithologic logging, and well construction will be conducted under the supervision of a California Registered Geologist. Prior to drilling the wells, a well permit will be obtained from the County of Los Angeles. Wells will be designed in accordance with the procedures outlined in the FSP, Department of Water Resources guidelines, and with applicable County of Los Angeles regulations.

3.1.3 Observation Well Installation

An observation well, OW-2, will be installed within approximately 50 feet of extraction well BF-EW-1 and G-EW-1 to obtain data regarding the hydraulic response in the lower Bellflower aquitard (Figure 11). No additional monitor wells are needed in the vicinity of these two extraction wells since these wells will be drilled in close proximity to existing upper Bellflower aquitard monitor well MW-14, Bellflower sand monitor well BF-7, and Gage aquifer monitor well G-6. Data from the observation well completed in the lower Bellflower aquitard will be used to evaluate the vertical hydraulic conductivity and leakance of this unit.

An observation well cluster, OW-3, will be installed within approximately 50 feet of extraction well BF-EW-2 to obtain data regarding the hydraulic response in the lower Bellflower aquitard and the Gage aquifer (Figure 11). Water level data from monitor well BF-17 will be used to verify the drawdown in the pumped aquifer near the extraction well. Data from the observation well completed in the lower Bellflower aquitard and Gage aquifer will be used to evaluate the vertical hydraulic conductivity and leakance of the lower Bellflower aquitard.

The observation well or cluster will be drilled using the mud rotary drilling method. The exploratory borehole described in Section 3.1.2 will be utilized to construct the observation well or well cluster. The lower portion of the exploratory boring may need to be grouted depending on the depth of the screened interval of the deepest well. Prior to reaming the boring, the lower portion of the borehole will be grouted with neat cement. The borehole will be reamed to a diameter sufficient to accommodate the individual casings, once the grout has cured. Observation well or well clusters will be constructed with individual 2-inch PVC casings and screens set in a single borehole. Details regarding the well construction, including the screen length, may be found in Appendix A, Table A-4. The annulus between individual well screens will be sealed with bentonite. The observation wells will be developed by bailing and pumping using a small diameter pump.

SOPs for the drilling, construction, and development of the extraction wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003). Well design, drilling, lithologic logging, and well construction will be conducted under the supervision of a California Registered Geologist. Prior to drilling the wells, a well permit will be obtained from the County of Los Angeles. Wells will be designed in accordance with the procedures outlined in the FSP, Department of Water Resources guidelines, and with applicable County of Los Angeles regulations.

These observation wells will be drilled on the same property as the extraction wells and thus, additional access to other property is not necessary.

3.1.4 Extraction Well Sampling And Analysis

Groundwater samples will be collected from the extraction wells at the end of the development phase for laboratory analysis of VOCs, including chlorobenzene, pCBSA, metals, pesticides and PCBs, semi-volatile organic compounds, and various miscellaneous compounds in accordance with the requirements of the General National Pollutant Discharge Elimination System (NPDES) Permits (Appendix A). A groundwater sample will be collected from the observation well cluster wells at the end of development for laboratory analysis of VOCs, including chlorobenzene, and pCBSA. These data will be used to assess the effluent water quality to the final treatment plant as well as the variability of the water quality compounds for RD purposes.

SOPs for the sampling of wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during groundwater sampling field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site Health and Safety Plan (H+A, 2003).

3.1.5 Extraction Well Testing

Groundwater extraction and injection testing will be completed as independent events. It is anticipated that extraction testing will require a minimum of 36 days to complete and that injection testing will require a minimum of 48 days to complete. Due to the extensive process involved with obtaining an NPDES Permit, it is likely that the injection tests will be completed prior to the extraction tests. Following are details regarding the extraction test which will be conducted upon completion of extraction well installation and upon approval of the NPDES Permit. Subsequent sections provide details regarding injection well installation and injection test protocols.

Pilot testing at the extraction wells will commence following well construction and development. It is anticipated that three separate testing events will be completed; one per extraction well. Testing will consist of a one-day step-test and then a constant-rate test. The constant-rate test will involve a 5-day, constant-rate groundwater extraction test followed by a groundwater recovery period during which time groundwater levels will be monitored until pre-testing elevations are observed. It is anticipated that the groundwater recovery period will last approximately 5 days. Therefore, it is likely that a total of 36 days will be required to complete extraction testing.

The purpose of the one-day step tests will be to assess the specific capacity at increasing extraction rates for each of the three extraction wells. The data obtained from the step-tests will be utilized to select the appropriate pumping rate for the long-term, constant-rate tests. The step-tests will consist of a minimum of three, two-hour long, steps at flow rates of approximately 150 gpm, 225 gpm and 300 gpm. The flow rates which are utilized during each of the step-tests will be finalized after installation of the extraction wells and will be based upon the performance observed during well-development.

Following each of the one-day step-tests, a five-day, constant-rate extraction test will be conducted at each of the three wells. The constant-rate tests will be completed at the optimum flow rate, as determined by evaluation of the step-test data. It is estimated that a total of 1.2 to 2.3 million gallons of treated groundwater will be recovered, treated, and discharged during the step and constant-rate tests at each of the extraction wells. The actual volume of water discharged will be dependent upon the discharge rate utilized during the constant-rate tests.

Prior to initiation of the step-test, static water levels will be manually measured in all wells to be monitored. In conjunction with collection of this data, transducers will be deployed in selected wells, including distant monitor wells for tracking background/regional water level changes, to measure groundwater levels and barometric pressure (Appendix A). Barometric pressure readings will be utilized to evaluate potential barometric effects on water levels. Transducers, programmed to record data at 5-minute intervals, will continue logging after completion of the step-tests to provide pre-test data for the constant-rate portions of the pilot test. Additionally, transducers will remain down-well following completion of the constant-rate tests to monitor the recovery of groundwater levels to pre-test elevations.

Three water level rounds will be conducted for each test, one before the test to establish static conditions, one at the end of the pumping phase, and one at the conclusion of the recovery phase of the test. For each test well, the wells to be monitored are sorted into three categories: Tier 1, Tier 2, and Tier 3 (Appendix A). The Tier 1 wells represent those wells which are nearest to the test well and therefore most likely to demonstrate observable influence. The Tier 2 and 3 wells are located at further distances from the test wells. If influence is observed at any of the outermost Tier 1 wells, monitoring will be extended to the Tier 2 wells. Monitoring will be further expanded to the Tier 3 wells if influence is observed in the outermost Tier 2 wells. Regardless of the extent of influence observed during the test, manual water level measurements will be taken at all Tier 1, 2, and 3 wells prior to the test. After completion of the test and after completion of recovery, manual water levels measurements will again be taken in Tier 1 wells, and Tier 2 and 3 wells, if appropriate.

A specific list of wells which will be monitored during these tests is included (Appendix A). Additional details regarding the field measurement protocol are included (Appendix A). SOPs for water level measurement and aquifer testing are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during water level measurement and aquifer testing field activities are provided in the QAPP (Appendix B).

A variety of protocols are in place in the event that a step-test or constant-rate test is interrupted. Due to the limited duration of the step-test, if an interruption of the test can not be resolved within 2 hours, a field assessment of data will be completed to determine if sufficient information has been collected to properly conduct the constant-rate portion of the test. If so, the test will be terminated; if not, testing will be resumed at such time that the cause of the interruption can be remedied.

Following is a summary of the procedures to be implemented for the constant-rate testing. For all alternatives below, it is expected that the duration of the test will be extended, at a minimum, for a period equal to the duration of the interruption. Additional extensions to the test are detailed, as appropriate, below.

- Shut-down period is less than 4 hours – upon identification of the cause of shut-down and subsequent resolution of the problem, all extraction and treatment equipment will be restarted and monitoring will resume at the pre-shut-down schedule.
- Shut-down period is greater than 4 hours
    - Overall test duration less than 48 hours
        - If the cause of the shut-down may be identified and subsequently remedied, testing will resume and field parameters will be monitored to determine the additional time required to reach pre-shut down conditions; the overall test duration will be extended by this amount of time. Monitoring will resume at the pre-shut-down schedule.
        - If the cause of the shut-down is not identified or if it is identified but can not be immediately remedied, testing will be repeated at such time that the cause of the interruption is resolved.
    - Overall test duration longer than 48 hours – data will be evaluated to determine if sufficient information is available to properly design the full-scale remediation system
        - If data are sufficient, testing will be terminated and collection of recovery will be initiated.

- If data are not sufficient, an attempt will be made to identify and remedy the cause of the interruption.
    - If the cause of the shut-down is identified and subsequently remedied; testing will resume and field parameters will be monitored to determine the additional time required to reach pre-shut down conditions; the overall test duration will be extended by this amount of time. Monitoring will resume at the pre-shut-down schedule.
    - If the cause of the shut-down is not identified or if it is identified but can not be immediately remedied, testing will be repeated at such time that the cause of the interruption is resolved.

Data obtained from the long-term test will be analyzed using a number of methods. Data will initially be evaluated using conventional Theis log-log and Jacob semi-log aquifer test analysis methods (Cooper and Jacob, 1946; Theis, 1935). If the test data deviate from the theoretical Theis response, then alternate methods of analysis may be used for evaluating the test data. Semi-log plots of drawdown vs. distance from the extraction well will also be prepared. These plots will be used to assess the hydraulic radius of influence of the pumped well. Results from the aquitard observation well will be used to evaluate the vertical hydraulic conductivity of the lower Bellflower aquitard using the Neuman-Witherspoon method of analysis (Neuman and Witherspoon, 1972). The long-term test will also be simulated using the groundwater model to validate the model hydraulic properties. In the event that the model is not able to replicate the observed hydraulic response to pumping, the model parameters will be adjusted to achieve a reasonable match to the observed water level response. This will also allow evaluation of potential deviations from Theis assumptions based on variability in aquifer geometry and properties and may aid in interpreting prior aquifer test data. The test results will also be used to better assess remediation well performance, well interference, capture area, and aquitard leakance.

3.2 INJECTION WELLS

As specified in the groundwater ROD, the groundwater remedy will include injection of treated groundwater into the Bellflower sand and Gage aquifers at the perimeter of the chlorobenzene plumes in these units. No injection well tests have been conducted to date. In order to design the injection wellfield, data are needed regarding sustainable injection rates; water level buildup in the injection well and aquifer; injection well specific capacity; and the potential for well plugging.

3.2.1 Proposed Injection Well Locations

In accordance with the groundwater ROD, injection wells will be located on either flank of the chlorobenzene plume in the Bellflower sand and Gage aquifer to dispose of treated groundwater as part of the groundwater remedy. Given the substantial plume width, aquifer characteristics may vary in these areas. It is therefore proposed that full scale pilot injection wells be installed on each flank of the chlorobenzene plumes in the Bellflower sand and Gage aquifer to obtain data in these areas. One injection well would be installed on each flank of the Bellflower sand plume and one on each flank of the Gage plume. A total of four injection wells would be installed and tested (Figures 11 and 12).

Locations for injection wells are less critical than for extraction wells because injection wells are primarily for disposal purposes and have less influence on plume size reduction. Pilot injection wells will be located east and west of the site along the Del Amo corridor. Injection wells have been located in areas believed to be outside of the known extent of elevated chlorobenzene, pCBSA, benzene, and TCE to minimize the potential for inducing adverse plume migration (H+A, 2004b). The eastern pilot injection wells are located in close proximity to existing groundwater monitoring wells, which will allow evaluation of aquifer response during the injection tests in this area. There are no existing monitor wells in the vicinity of the proposed western pilot injection wells. A small diameter observation well cluster will be installed on the western flank of the plume in both the Bellflower sand and Gage aquifer so that aquifer response can be measured during the injection test. It is anticipated that a nearby fire hydrant will be identified and used as the source water for injection testing.

Injection wells BF-IW-1 and G-IW-1 are proposed to be installed on private property occupied by Tireco (Figures 11 and 12). The proposed location for injection well BF-IW-1 was selected to be just beyond the estimated western flank of the chlorobenzene plume. However, because there are no monitor wells in the immediate vicinity of BF-IW-1, there is a possibility that chlorobenzene or other VOCs may extend into this area. Two alternate locations have been selected for injection well BF-IW-1 should the initial location be found to be unsuitable due to elevated VOC concentrations (Figure 11). Alternate locations were designated along the Del Amo corridor nearest to the Bellflower sand chlorobenzene plume where access appears to be feasible. Although Gage injection well G-IW-1 appears to be well outside of the chlorobenzene plume in this unit, two alternate locations have also been identified in case access cannot be obtained to the Tireco property.

Prior to constructing Bellflower sand injection well BF-IW-1, a groundwater sample will be obtained from the Bellflower sand by installing a temporary well in the planned exploratory borehole. The exploratory boring will be drilled using small diameter mud rotary drilling and coring equipment to obtain data for the injection well design. Prior to grouting the exploratory boring, the mud will be thinned and a temporary well casing and 0.020-inch slotted screen assembly will be installed within the Bellflower sand. The screen will be filter packed with #2-/16 Lonestar sand. A two-foot #60 silica sand grout filter will be placed over the filter pack using a tremie pipe. A ten-foot bentonite pellet annular seal will then be emplaced above the sand, opposite the overlying aquitard sediments and allowed to hydrate. The temporary well will be surged and pumped for several hours to remove the residual drilling mud. After field parameters have stabilized, a groundwater sample will be collected from a low flow tap on the submersible pump discharge for laboratory analysis. The sample will be analyzed on an expedited 24-hour turn around time for VOCs and pCBSA using EPA Methods 8260 and 314.0.

Following the collection of the grab sample, the temporary casing and screen will be pulled from the exploratory boring and the exploratory boring will be completed and geophysically logged. If the grab sample concentrations are approximately equal to or less than the Maximum Contaminant Levels (MCLs) for individual VOCs, the exploratory boring will be completed as an observation well cluster. The injection well will then be constructed near the observation well cluster as planned.

If the grab sample concentration exceeds the approximate MCL for any individual VOC, the exploratory boring will be abandoned by pressure grouting and the injection well and observation well cluster will then be constructed at one of two alternate locations as indicated on Figure 11.

If the concentrations for individual VOCs are approximately equal to or less than their respective MCLs, then the injection well will be installed as planned. If the groundwater concentration exceeds the approximate MCL for an individual VOC, then the injection well will be installed at one of the two alternate locations.

Injection well BF-IW-2 is proposed to be installed on property owned by Alpine Village. Injection well G-IW-2 is proposed to be installed on the former Del Amo site, on land under the control of the County of Los Angeles, Department of Water and Power. Montrose has begun the access process.

3.2.2 Injection Well Design And Installation

The injection wells will be designed and constructed using methods and materials typically used for full scale production wells so that they will be suitable for use in the final groundwater remedy. Based on data obtained from previous short-term aquifer tests conducted during the RI, achievable injection well capacities may range from approximately 50 to more than 150 gpm.

Prior to installing the injection wells, a small diameter exploratory boring will be advanced at each injection well location using a mud-rotary drill rig to provide the lithologic data required to ensure a proper well design. Grain size analyses will be conducted on selected core samples to evaluate proposed well screen slot sizes. Additional soil samples from the injection zone will be analyzed for cation exchange capability to determine the concentration of various cations in core samples and x-ray diffraction to quantify the percentage of minerals and clays in the core samples. These analyses may be needed to evaluate potential in situ geochemical reactions caused by incompatibility with the injection water.

At the western injection well site, the exploratory boring will be reamed out and an observation well cluster will be installed as described in Section 3.2.3 (Figure 11). At the eastern injection well site, a well cluster is not necessary since the injection well will be located close enough to the existing monitoring wells to allow the aquifer response to be monitored during injection. This exploratory boring will be grouted from the bottom up using a tremie pipe.

The injection wells will be drilled using the conventional mud-rotary drilling method. A mild steel conductor casing will first be installed and cemented in place from ground surface to near the base of the aquitard overlying the target aquifer zone. The borehole will then be advanced to the total depth. Because pumping of the injection well is required for initial development and periodic redevelopment during the groundwater remedy, the well casing diameter will be sufficiently large to accommodate the development pump and downhole injection control equipment that may be required. The well screen will consist of 12-inch 316L stainless steel wire wrap screen. The screen interval will be selected to fully penetrate the B and C units of the Bellflower sand or the Gage aquifers. The well head will be fitted with a water tight flange to allow the well pressure to be shut in, if necessary. Openings in the wellhead will be provided for installing necessary pumping, injection, and monitoring equipment. The wellhead may be completed above ground if located in an undeveloped area or in a below ground vault if constructed in a developed area such as in a street.

The injection wells will be developed using a combination of bailing, swabbing, jetting, air-lifting, and/or pumping. The filter pack will be monitored during development and replenished as needed if settling occurs. Following development, the annular space between the well and conductor casing will be sealed with bentonite grout. A stainless steel plate will be welded between the conductor casing and well casing to ensure a positive wellhead seal.

SOPs for the drilling, construction, and development of the injections wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003). Monitor well design, drilling, lithologic logging, and well construction will be conducted under the supervision of a California Registered Geologist. Prior to drilling the wells, a well permit will be obtained from the County of Los Angeles. Wells will be designed in accordance with the procedures outlined in the FSP, Department of Water Resources guidelines, and with applicable County of Los Angeles regulations.

3.2.3 Observation Well Cluster Installation

An observation well cluster will be installed within approximately 50 feet of injection wells BF-IW-1 and G-IW-1 to obtain data regarding the hydraulic response in the Bellflower sand and the Gage aquifer (Figure 11). Water level data from the observation well cluster will be used to verify the buildup in the aquifer near the injection well.

The observation well cluster will be drilled using the mud rotary drilling method. A pilot borehole will be initially advanced using continuous coring in selected intervals to verify hydrogeologic conditions and screen placement. The borehole will be reamed to a diameter sufficient to accommodate the individual casings. Observation well clusters will be constructed with individual 2-inch PVC casings and screens set in a single large diameter borehole. The annulus between individual well screens will be sealed with bentonite. Details regarding the well construction, including the screen length, may be found in Appendix A, Table A-4. The observation wells will be developed by bailing and pumping using a small diameter pump.

SOPs for the drilling, construction, and development of the extraction wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site Health and Safety Plan (H+A, 2003). Well design, drilling, lithologic logging, and well construction will be conducted under the supervision of a California Registered Geologist. Prior to drilling the wells, a well permit will be obtained from the County of Los Angeles. Wells will be designed in accordance with the procedures outlined in the FSP, Department of Water Resources guidelines, and with applicable County of Los Angeles regulations.

The observation well will be drilled on the same property as the injection wells and thus, additional access to other property is not necessary.

3.2.4 Injection Well Sampling and Analysis

Prior to constructing BF-IW-1, a groundwater sample will be obtained from the Bellflower sand by installing a temporary well in the planned exploratory borehole. Following surging and pumping of the well, field parameters will be allowed to stabilize. A groundwater sample for laboratory analysis will then be collected utilizing low flow techniques. The sample will be analyzed with an expedited turn-around-time for VOCs and pCBSA. The water quality data will be used to verify that injection well BF-IW-1 is located sufficiently outside of the contaminant plume as described in Section 3.2.1,

A groundwater sample for laboratory analysis of VOCs, including chlorobenzene, pCBSA, and additional inorganic compounds and water quality parameters will be collected from each injection well at the end of development. A groundwater sample will also be collected from the observation wells at the end of development for laboratory analysis of VOCs, including chlorobenzene, and pCBSA. These data will be used to assess the ground water quality within the proposed injection zones prior to commencing injection testing operations. The water quality data will be used to verify that the injection wells are sufficiently outside of the contaminant plumes and to evaluate native and treated water compatibility issues.

SOPs for the sampling of wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during groundwater sampling field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003).

3.2.5 Injection Well Test Procedure

The injection tests will be independent tests done in series. Pilot injection testing will commence following injection well construction and development. It is anticipated that four separate testing events will be completed; one per injection well. Each testing event will consist of a one-day step test, followed by a constant-rate test. The constant-rate test will involve a 5-day constant-rate injection of potable water event followed by a groundwater recovery period during which time groundwater levels will be monitored until pre-testing elevations are observed. It is anticipated that the groundwater recovery period will last approximately 5 days. Therefore, it is likely that a total of 48 days will be required to compete injection testing.

The purpose of the one-day step test will be to assess the efficiency and specific capacity at increasing injection rates for each of the four injection wells. The data obtained from the step test will be utilized to select an appropriate injection rate for the long-term, constant rate injection tests. The step-tests will consist of a minimum of three, two-hour long steps.

Following each of the one-day step tests, a five-day, constant-rate injection test will be conducted at each of the four wells. The 5-day constant-rate, potable water injection tests will be completed at the optimum flow rate, as determined by evaluation of the step-test data. Water level data will be obtained from the injection well, nearby monitor wells, and newly installed observation wells screened in the injection zone.

Three water level rounds will be conducted for each test, one before the test to establish static conditions, one at the end of the pumping phase, and one at the conclusion of the recovery phase of the test. For each test well, the wells to be monitored are sorted into three categories: Tier 1, Tier 2, and Tier 3 (Appendix A). The Tier 1 wells represent those wells which are nearest to the test well and therefore most likely to demonstrate observable influence. The Tier 2 and 3 wells are located at further distances from the test wells. If influence is observed at any of the outermost Tier 1 wells, monitoring will be extended to the Tier 2 wells. Monitoring will be further expanded to the Tier 3 wells if influence is observed in the outermost Tier 2 wells. Regardless of the extent of influence observed during the test, manual water level measurements will be taken at all Tier 1, 2, and 3 wells prior to the test. After completion of the test and after completion of recovery, manual water levels measurements will again be taken in Tier 1 wells, and Tier 2 and 3 wells, if appropriate.

It is anticipated that the injection tests will be conducted utilizing potable water from fire hydrants. Written notification has been provided to the EPA Underground Injection Control Program and the California Regional Water Quality Control Board (RWQCB), Los Angeles Region (H+A, 2004c and 2004d). Additionally, the Los Angeles Department of Water and Power (LADPW) and the Rancho Dominguez District of the California Water Service Company will be contacted regarding connection to fire hydrants which will be utilized as a potable water source. If suitable hydrants are unavailable, an alternative potable water source, such as a connection to a city water supply, may be utilized. Regardless of the source, potable water will be filtered prior to injection in order to minimize the potential for well plugging due to suspended sediment, as detailed in Section 5. The estimated potable water usage for these tests is estimated to be a total of approximately 1,440,000 gallons or 4.4 acre-feet of potable water.

Monitoring during the injection tests will include, but not be limited to, water level responses in the injection zone, water table levels in several surrounding wells, and injection flow rates. Prior to initiation of the step-test, static water levels will be manually measured in all wells to be monitored. In conjunction with collection of this data, transducers will be deployed in selected wells, including distant monitor wells for tracking background/regional water level changes, to measure groundwater levels and barometric pressure. Barometric pressure readings will be utilized to evaluate potential barometric effects on water levels. Transducers, programmed to record data at 5-minute intervals, will continue logging after completion of the step-tests to provide pre-test data for the constant-rate portions of the pilot study. Additionally, transducers will remain down-well following completion of the constant-rate tests to monitor the recovery of groundwater levels to pre-test elevations. A specific list of wells which will be monitored during these tests is included (Appendix A). Additional details regarding the field measurement protocol are included in (Appendix A).

A variety of protocols are in place in the event that a step-test or constant-rate test is interrupted. Details are included in Section 3.1.5 of this work plan; a procedure identical to the extraction test will be implemented in the event of an interruption during an injection test. Details for identifying the cause of well-plugging, if this is the cause of the interruption, are included in Section 5.

The data obtained from the constant-rate test will be utilized to evaluate numerous site and system design parameters including: aquifer transmissivity, hydraulic conductivity, storativity in the vicinity of the injection wells, and injection well specific capacity and efficiency. Eventually, injection wells will be utilized for injection of groundwater that is recovered and treated as part of the full-scale remedial solution of this site. Therefore, information obtained from injection testing will be incorporated into the groundwater model, as described in Section 2, in order to minimize uncertainty in the remedial system injection well-field design.

Procedures for conducting constant-rate injection tests are similar to conducting conventional aquifer tests. SOPs for aquifer testing are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during aquifer testing field activities are provided in the QAPP (Appendix B).

4.0 TREATMENT AND DISPOSAL OF WATER

In accordance with Section 4.1 of the SOW for UAO, the following provides a description of the treatment and disposal system to be implemented for the pilot extraction and aquifer response testing. Locations of the nearest storm drains have been provided (Figures 13 and 14). In addition, the treatment process, pilot installation and startup, operation and maintenance procedures, and ancillary facilities are discussed. A process flow diagram for the pilot extraction treatment system has been provided (Figure 15). Montrose will obtain an NPDES permit from the Los Angeles Regional Water Quality Control Board prior to discharging water from the extraction testing.

Given the duration of the aquifer test, electricity for the aquifer test pump will be provided by an internally regulated 60-kilowatt engine driven generator. Since testing is proposed at flows ranging from 150 to 300 gpm, it is likely that more than one pump will be utilized (Figure 15). The aquifer test pumps will be constructed of stainless steel, and have discharge pressures of up to 270 feet of water at 300 gpm, and a shutoff pressure of 580 feet of water or 250 pounds per square inch gage (psig). The aquifer test pump will have a 30 horsepower, 480 volt, three phase motor and will be installed in the extractions wells at depths up to 145 feet bls. The aquifer test pumps will be installed in the well using 3-inch nominal galvanized carbon steel pipe. Exact specifications will be finalized prior to initiation of the test.

The groundwater extraction rate from the test well will be measured using a positive displacement or a turbine style flow meter. The flowrate from the flow meter will be verified at the start of testing based on comparison to a second factory-calibrated flow meter. The groundwater extraction rate will be adjusted to maintain flowrate by adjusting a flow control valve. The conveyance piping from the aquifer test pump will be carbon steel with a pressure rating exceeding the maximum output pressure of the pump. All the components of the pilot extraction test will be designed and selected to have a pressure rating greater than the maximum pump pressure. Conveyance piping from the treatment system to storm drain discharge location will be schedule 40 PVC.

A temporary groundwater treatment system consisting, at a minimum, of skid mounted carbon vessels will be set up adjacent to, or in close proximity to each test extraction well (Figure 15). The treatment system will include a U.S. Filter® Model PV810L skid-mounted carbon absorption system. The PV810L system includes two 10,000-pound capacity vessels that are operated in series. The carbon vessels are designed for pressure up to 75 psig and flowrates up to 500 gpm. Each vessel contains approximately 10,000 pounds of granular activated carbon. Additionally, pre- and post-carbon solids filtration will be utilized to reduce solids loading to the carbon and discharge to the storm drain. If necessary based on NPDES requirements, an additional treatment unit may be utilized for metals treatment. The carbon vendor will provide the interconnecting valve skid.

Groundwater will be pumped through the system by the aquifer test pump. Sampling ports will be provided at the inlet and outlet of the system and between the two carbon adsorbers. Treated groundwater will be discharged into the nearest storm drain (Figures 13 and 14). The treatment system may be modified as necessary based on NPDES permit requirements.

Start up of the pilot extraction test system will consist of pre-start preparations and normal system start. Pre-start preparations will include leak testing of the treatment system piping, and verifying operation of the pump control system. In addition, prior to the start of each aquifer test instrument readings will be recorded from the extraction well and treatment system, and all valves will be configured for proper operation. The motor driven generator will be started and warmed up in accordance with manufacturer's operating requirements. Once the system is deemed ready to operate, the well pump will be activated.

During the pilot extraction tests, a field technician will be onsite on a continuous basis to record data on the treatment system, to monitor treatment system performance, and perform system maintenance. The technician will check the status of the pilot extraction test on a frequent basis to make necessary adjustments to flowrates; monitor the status of the carbon adsorption system; monitor the status of the generator; and monitor water levels. Field data forms have been prepared to document field measurement data and test operating conditions (Appendix A). Treatment system field notes will be entered as required and will include a record of any operation. Monitoring of the extraction and treatment system during operation will include recording all extraction well totalizer readings and discharge pressures along with the time and date of the measurement. The instantaneous flowrate from each extraction well will be determined and the control valve adjusted as necessary. Additionally, the discharge point will be visually inspected prior to and on a periodic basis throughout the test to confirm that treated groundwater is discharging properly. A more detailed monitoring protocol is included (Appendix A).

All wellheads and pipelines, and the treatment system, will be inspected on a regular basis. Preventative measures, such as equipment inspections prior to installation, will be taken to reduce the risk of equipment failure. Spare equipment will be available to ensure that down time is minimized. The generator will be fueled and serviced by the generator vendor on a periodic basis to provide reliable power to the aquifer test pump.

Monitoring will be required in accordance with the NPDES permit. The sampling schedule and frequency of monitoring will be determined by the RWQCB when they approve the NPDES permit.

5.0 FILTRATION AND INJECTION OF WATER

In accordance with Section 4.1 of the SOW for UAO, the following provides a description of the filtration and injection system to be implemented for the pilot extraction and aquifer response testing. The injection water will be potable water obtained from the nearest fire hydrant (Figures 16 and 17). In addition, pilot installation and startup, operation and maintenance procedures, and ancillary facilities are discussed. A process flow diagram for the injection system has been provided (Figure 18).

Water for the injection testing will be obtained from the Los Angeles Department of Water and Power (DWP) or the California Water Service Company fire hydrant. Prior to initiation of injection testing, a permit will be obtained from DWP to connect to the nearest fire hydrant for each injection well. Since potable water will be used in the injection testing, it is anticipated that an injection permit will not be required. Both EPA and the RWQCB have been notified of the intent to inject potable water prior to the initiation of the injection testing (H+A, 2004c and 2004d).

In order to maximize the efficiency of the injection wells, consideration was given to a number of likely causes for well plugging: biological fouling, air locking, and sediment build-up. To minimize/eliminate plugging due to biological fouling, potable water, which typically contains residual chlorine, will be utilized for injection. The chlorine in potable water prevents biological growth. Field measurement of the chlorine levels will be completed to ensure that there is indeed chlorine present and that biological fouling may be excluded as a possible cause of fouling. To minimize/eliminate the potential for an air lock in the well to reduce injection capacity, proper equipment will be utilized for connection to the injection well and for delivery of the potable water.

The remaining and most likely source of well plugging is sediment build-up in the injection wells. Therefore, prior to injecting potable water into the injection wells, the water will be filtered to remove suspended solids. Additionally, a bypass filter assembly will be installed downstream of the primary filter bank. A small percentage of the injection water will be diverted to the bypass filter assembly which will contain a filter with a micron rating smaller than the most restrictive filter(s) utilized in the main bank. This will allow assessment of the size and amount of solids which are progressing through the main filter bank and therefore are being injected into the well. If well plugging is observed, identified by a rise in the water level or a reduction in the injection rate, the differential pressure across the bypass filter assembly will be assessed and the actual filter will be inspected. If solids loading is evident, adjustments will be made to the main filter system to resolve plugging due to sediment build-up such as utilization of additional filters and/or utilization of filters with a smaller micron rating.

A water meter will be installed on each hydrant by DWP to monitor the volume of water used. An isolation valve and backflow preventor will be installed down stream of the DWP water meter in accordance with DWP requirements for temporary water services. After the DWP fire hydrant equipment, the injection system will consist of a bag filter system, a flow meter, pressure gauges, and a flow control valve (Figure 18). The bag filter system will consist of two parallel trains of three bag filters in series to minimize the potential disruption to the injection test. Each filtration train will consist of three bag filters in series, with 20, 5, and 1-micron elements. The filtered water flowrate will be measured using a positive displacement or turbine style flow meter. Flow rate will be controlled using a manual globe valve. Water will be conveyed to the injection well via a PVC pipeline.

Prior to conducting the injection test, the water conveyance pipelines and appurtenances will be pressure tested to check for leaks. Start up of the injection system will consist of pre-start preparations and normal system start. Pre-start preparations will include inspecting each injection well wellhead for proper valve configuration, and verifying the correct positions for all control and isolation valves. In addition, prior to the start of each aquifer test, instrument readings will be recorded from flow meters. Once the system is deemed ready to operate, the isolation valves will be opened and the injection rate adjusted to the test rate.

During the pilot injection tests, a field technician will be onsite, at a minimum, on a daily basis to record data on the injection system, to monitor injection system performance, and perform system maintenance. The technician will check the status of the pilot injection well to make necessary adjustments to flowrates; monitor the status of the filter system; and monitor water levels. The differential pressure across the filter elements will be monitored, at a minimum daily, during the pilot injection test, and the filter element will be changed when the differential pressure across the filter element approaches the manufacturer's recommend operating criteria. The spent filter element will be placed in containers for appropriate off-site disposal.

Field data forms have been prepared to document field measurements data and test operating conditions (Appendix A). Injection system field notes will be entered as required, and will be include a record of operation. Monitoring of the injection system during operation will include recording all injection well flow totalizer and pressures along with time and date of the measurement. The instantaneous flowrate to each injection well will be determined and the control valve adjusted as necessary.

All wellheads and pipelines, and the filter system, will be visually inspected on a daily basis. Preventative measures, such as equipment inspections prior to installation, will be taken to reduce the risk of equipment failure. Spare parts and equipment will be available to ensure that down time is minimized.

6.0 HEALTH AND SAFETY

All on-site field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003). The Site-specific Health and Safety Plan will be included in the field version of the FSP.

On-site field personnel will have 40-Hour Hazardous Waste Operations and Emergency Response training and current 8-Hour Refresher Training in accordance with 29 CFR 1910.120. Field personnel will also have certification of current respirator fit-testing and first aid training.

A number of precautions will be taken to minimize the risk to both the public and also equipment operators. Traffic control measures including the use of flag men, road construction signage, and delineators will be utilized where traffic controls are required. Temporary fencing will be set around each drilling location and will be utilized, as needed, during potable water injection and groundwater recovery activities. The drill rig and other drilling equipment will be locked and secured each night prior to departing the site for the evening. Equipment utilized during the injection and recovery tests will be under 24-hour observation by equipment operators. Additionally, a security guard will remain at the drilling and test sites overnight. In addition, local law enforcement agencies will be asked to monitor the drilling and testing sites.

7.0 SCHEDULE AND REPORTING

A proposed schedule based on the UAO SOW for the model refinement program is provided as Figure 19. Following completion of the pilot extraction and aquifer response testing field activities, a completion report will be prepared and submitted to EPA. Information to be provided as part of this report is specified in the UAO SOW Section 4.3. The Completion Report will include:

- Objectives of the aquifer response testing and any issues that occurred relative to meeting the objectives.
- Documentation and a chronological discussion of the preparation and running of the test.
- Discussion of the bases of measurement and performance criteria.
- Description of the field activities documentation and well or equipment installation tasks.
- Methods and procedures followed during the pilot extraction and aquifer response testing, including a description of events in the field that provide either context or impact the results of the testing.
- Field notes and discussion confirming how the pilot extraction and aquifer response tests were performed.
- Documentation of the test durations.
- Calculations and step-by-step intermediate and final results from the methodology to reduce the test data to generate estimates of aquifer response parameters.
- Appendix showing the raw drawdown and/or recovery data.
- Summary of conclusions and measured values.
- Documentation of field activities and other data derived from the tests.
- Description of the capture, storage, and/or disposal of extracted groundwater during the tests.
- Description of the field activities documenting well drilling and construction; sampling and analysis methods and procedures; and how these differ from the FSP.
- Summary of the existing data regarding the distribution of the chlorobenzene plume in the vicinity of the former Montrose property.
- Results of any groundwater quality sampling or measurements.

- Graphics depicting hydrostratigraphic cross-sections
- Information necessary to document the installation and sampling of the new monitor wells.

The Completion Report will be provided to EPA approximately 20 business days after completion of the aquifer response testing and review of the test results.

Data collected during the pilot extraction test program including flowrate data, water level data, parameter data collected during well purging, and laboratory analytical data will be entered into the project database. Data will be managed in accordance with the Data Management Plan (H+A, 2004a).

8.0 REFERENCES

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TABLE 1

CHLOROBENZENE IN GROUNDWATER

WELL IDENTIFIER	PREVIOUS RESULT (DATE)	RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
	CONCENTRATION (micrograms per liter)				
Upper Bellflower Aquitard Monitor Wells					
MW-01	78,000 (11/29/95)	1,400	-	78,000	130,000
MW-03	<1 (11/20/91)	<1	-	59	<2/<1 (SPT)
MW-04	500 (04/20/90)	58	-	1,600	3,900
MW-05	8.4 (11/28/95)	8.4	-	200,000	480/380 (FD)
MW-06	190 (12/01/95)	190	-	13,000	130/130 (FD)
MW-08	<1 (04/20/90)	<1	-	5.0	5.1
MW-09	8,400 (11/30/95)	8,400	-	180,000	320
MW-10	820 (04/20/90)	790	-	2,200	31
MW-11	20,000 (04/18/90)	18,000	-	34,000	930/780 (SPT)
MW-12	4,100 (12/02/95)	3,200	-	8,200	2,800
MW-13	2,600 (04/21/90)	1,700	-	3,200	11,000
MW-14	400 (04/17/90)	130	-	900	160/160 (SPT)
MW-16	<20 (10/14/02)	<5	-	<20	<2
MW-17	4.4 (10/15/02)	2.0	-	7.5	<2/<2 (FD)
MW-19	3.4 (11/30/95)	<1	-	9.0	3.3
MW-22	<2 (10/10/02)	<1	-	<2	<2
MW-25	210 (10/15/02)	44	-	990	340
MW-26	<2 (10/16/02)	<1	-	9.0	<2
MW-27	3.9 (12/02/95)	3.9	-	15	<2/2 (SPT)
MW-30	<2 (10/15/02)	<1	-	<2	<2
Bellflower Sand Monitor Wells					
BF-01	86 (01/25/99)	86	-	570	11
BF-02	4,700 (04/20/90)	3,600	-	16,000	47,000
BF-03	9,000 (04/20/90)	9,000	-	23,000	13,000
BF-04	30,000 (11/19/91)	23,000	-	42,000	15,000
BF-05	2 (10/14/02)	2.0	-	3,400	6.4

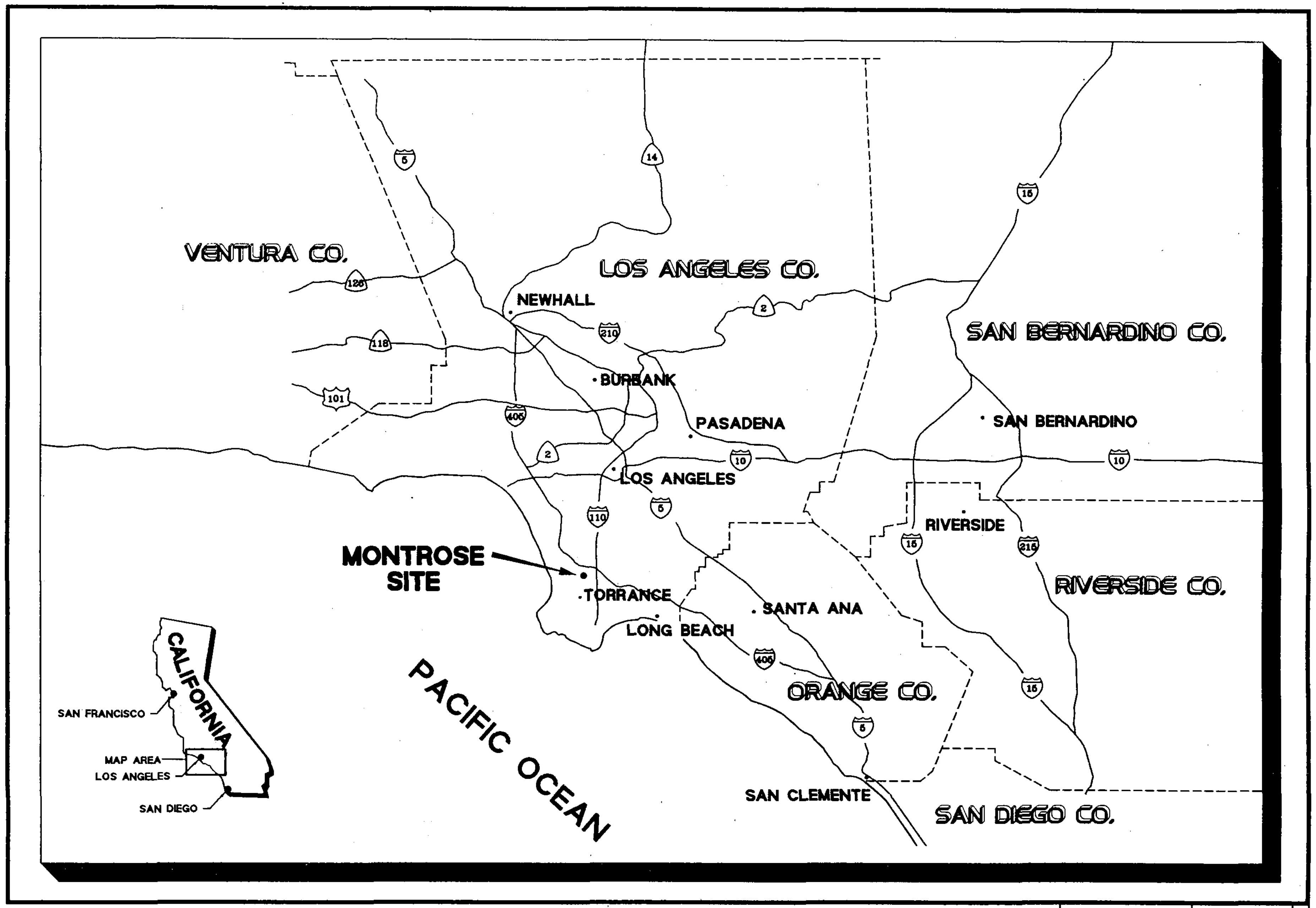
TABLE 1 (continued)
CHLOROBENZENE IN GROUNDWATER

WELL IDENTIFIER	CONCENTRATION (micrograms per liter) PREVIOUS RESULT (DATE)	RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
Bellflower Sand Monitor Wells (continued)					
BF-06	23,000 (01/22/99)	23,000	-	34,000	26,000
BF-07	31,000 (01/22/99)	31,000	-	66,000	25,000
BF-09	25,000 (01/25/99)	11,000	-	25,000	19,000
BF-10	<1 (01/20/99)	<1	-	<1	17
BF-11	2,300 (08/04/90)	190	-	2,300	8,800
BF-12	450 (10/08/02)	<1	-	580	330/390 (FD)
BF-14	2,000 (08/05/90)	1,200	-	2,000	730
BF-15	21,000 (01/25/99)	21,000	-	42,000	8,300
BF-16	2,000 (01/20/99)	150	-	2,000	3,000/2,700 (SPT)
BF-17	2,700 (01/22/99)	2,300	-	4,300	5,200
BF-19	<1 (01/20/99)	<1	-	<1	<2
BF-20	29 (01/21/99)	29	-	1,000	1,800/2,100**
BF-21	1,500 (01/21/99)	1,500	-	8,900	1,800/1,400 (SPT)
BF-22	450 (06/18/91)	360	-	450	420/410 (FD)
BF-24	4,300 (01/22/99)	4,300	-	17,000	18,000
BF-25	320 (01/19/99)	62	-	320	21
BF-26	5 (10/08/02)	5.0	-	46	3.6
BF-27	<2 (10/09/02)	<1	-	<2	<2/<2 (FD)
BF-28	<2 (10/08/02)	<1	-	5.0	<2
BF-29	620 (08/08/91)	270	-	620	130
BF-30	<2 (10/09/02)	<1	-	<2	<2
BF-31	18 (10/10/02)	18	-	430	21
BF-32A	24 (10/09/02)	<1	-	180	<2
BF-33	<2 (10/09/02)	<1	-	<2	<2
Gage Aquifer Monitor Wells					
G-01	190 (11/21/91)	170	-	710	990/800 (SPT)

TABLE 1 (continued)
CHLOROBENZENE IN GROUNDWATER
Page 3 of 3

WELL IDENTIFIER	PREVIOUS RESULT (DATE)	RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
	CONCENTRATION (micrograms per liter)				
Gage Aquifer Monitor Wells (continued)					
G-02	6,900 (11/21/91)	6,900	-	20,000	17,000
G-03	1,100 (01/27/93)	240	-	2,200	470
G-04	1,400 (11/21/91)	9.0	-	2,000	96/93 (FD)
G-05	14,000 (04/21/90)	1,700	-	22,000	3,500
G-06	2,400 (04/18/90)	2,100	-	4,600	2,000
G-08	75 (11/20/91)	73	-	120	710
G-09	170 (10/10/02)	<2	-	170	370
G-11	5 (10/11/02)	<1	-	5.0	15
G-13	1,700 (11/21/91)	1,100	-	1,700	4,400
G-15	11 (10/11/02)	11	-	19	13
G-16	<2 (10/11/02)	<1	-	<2	<2
G-17	200 (07/03/91)	150	-	200	430
G-18	<2 (10/08/02)	<1	-	<2	<2
G-19	7,400 (10/10/02)	<1	-	7,400	12,000
SWL0034	8,600 (07/19/00)	5,400	-	11,000	6,600
Lower Gage Monitor Wells					
LG-01	70 (08/03/90)	33	-	110	9.5
LG-02	390 (04/19/90)	180	-	390	120
Lynwood Aquifer Monitor Wells					
LW-01	83 (10/17/02)	<1	-	560	64/75 (FD)/71 (SPT)
LW-02	<2 (10/14/02)	<1	-	<2	8.4
LW-03	<2 (10/14/02)	<1	-	<2	<2
LW-04	<2 (10/11/02)	<1	-	<2	<2
LW-06	<2 (10/17/02)	<1	-	<2	<2

* = Based on original sample results only.
** = Reanalysis result
Sampling results in tabulation are original samples unless specified with the following codes:
SPT = Split Sample, FD = Duplicate Sample
< = Less than; numerical value is detection limit for analyte



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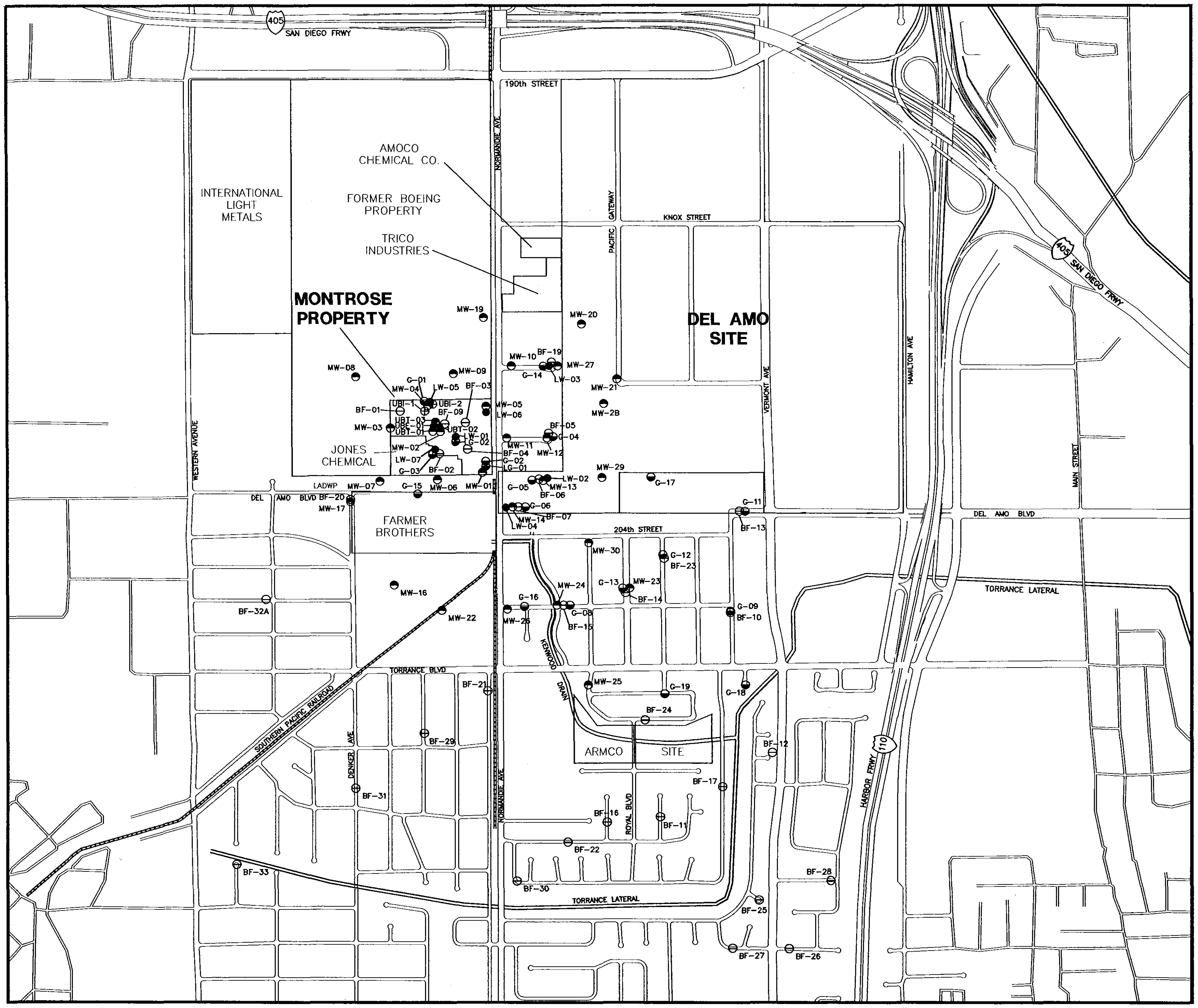
RPT NO. 857 | 410-3831 | A

FIGURE 1. SITE LOCATION



EXPLANATION

MW-25	UPPER BELLFLOWER AQUITARD MONITOR WELL
UBE-1	UPPER BELLFLOWER AQUITARD EXTRACTION WELL
UBT-3	UPPER BELLFLOWER AQUITARD OBSERVATION WELL
UBI-1	UPPER BELLFLOWER AQUITARD INJECTION WELL
BF-17	BELLFLOWER SAND MONITOR WELL
G-7	GAGE AQUIFER MONITOR WELL
LW-7	LYNWOOD AQUIFER MONITOR WELL

NOTE: THIS MAP SHOWS LOCATIONS FOR MONITOR WELLS CONSTRUCTED BY MONTROSE DURING REMEDIAL INVESTIGATION ACTIVITIES AND DOES NOT INCLUDE MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY OTHERS FOR OTHER INVESTIGATIONS.

N

0 1,000 2,000

FEET

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TORRANCE, CALIFORNIA

MONITOR WELL LOCATIONS

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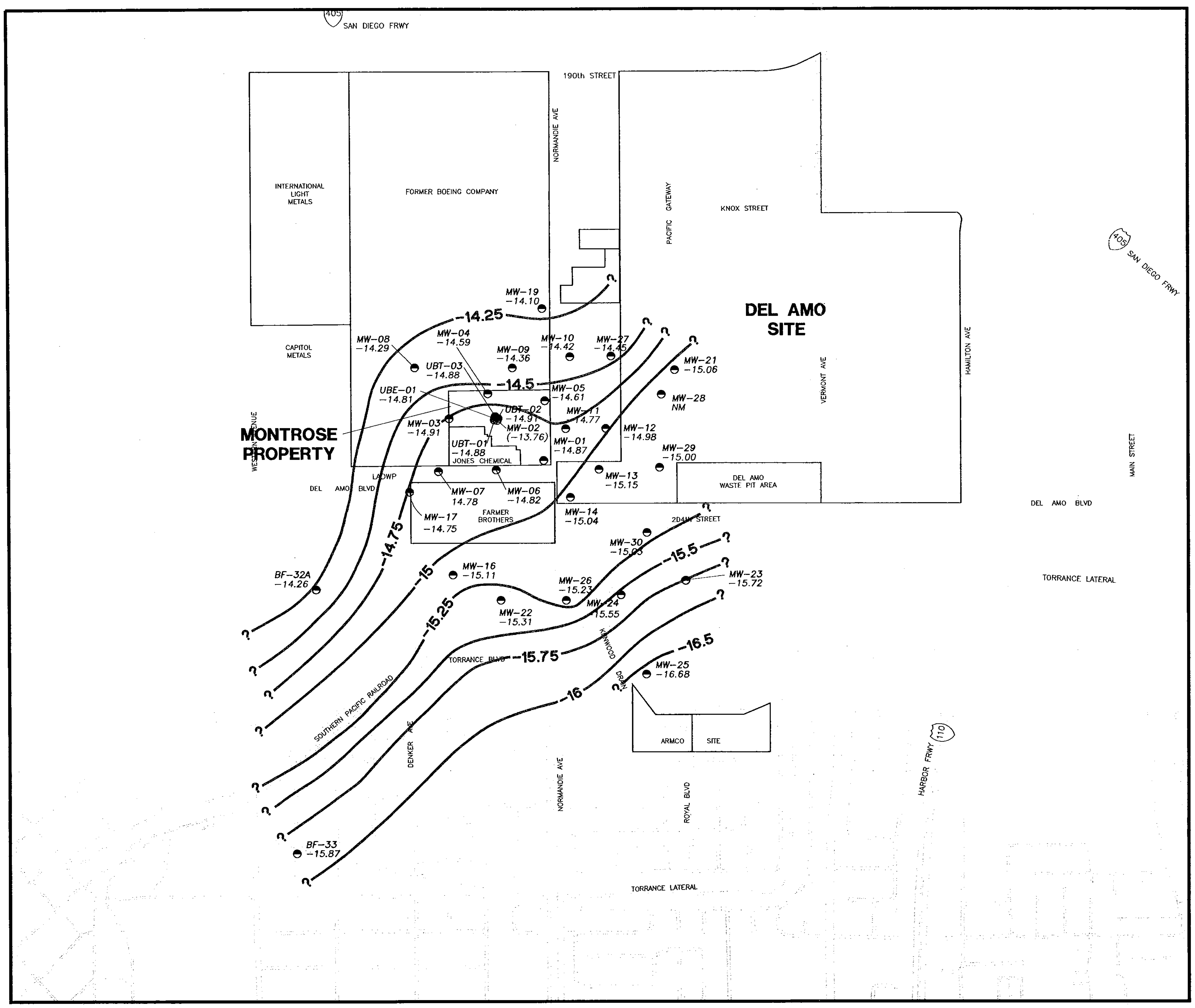
FIGURE 2

PREP BY SPN REV BY MAP RPT NO. 857.38 | 410-4696 | A

BOE-C6-0012864



EXPLANATION

- MW-19 — UPPER BELLFLOWER AQUITARD MONITOR WELL
- UBE-1 — UPPER BELLFLOWER AQUITARD EXTRACTION WELL
- UBT-3 — UPPER BELLFLOWER AQUITARD OBSERVATION WELL
- -14.2 — WATER LEVEL ELEVATION (FEET MEAN SEA LEVEL)
- ( ) — NOT CONTOURED
- NM — NOT MEASURED
- * — FREE PRODUCT ENCOUNTERED. WATER LEVEL ELEVATION ADJUSTED FOR PRESENCE OF PRODUCT
- ? —— -18 —— ? — CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED.

NOTE: WATER LEVELS MEASURED JANUARY 12-13, 2004
WATER LEVELS AT MW-01, MW-02, MW-03 AND MW-05 MEASURED FEBRUARY 6, 2004

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UPPER BELLFLOWER AQUITARD WATER LEVEL ELEVATION JANUARY 2004

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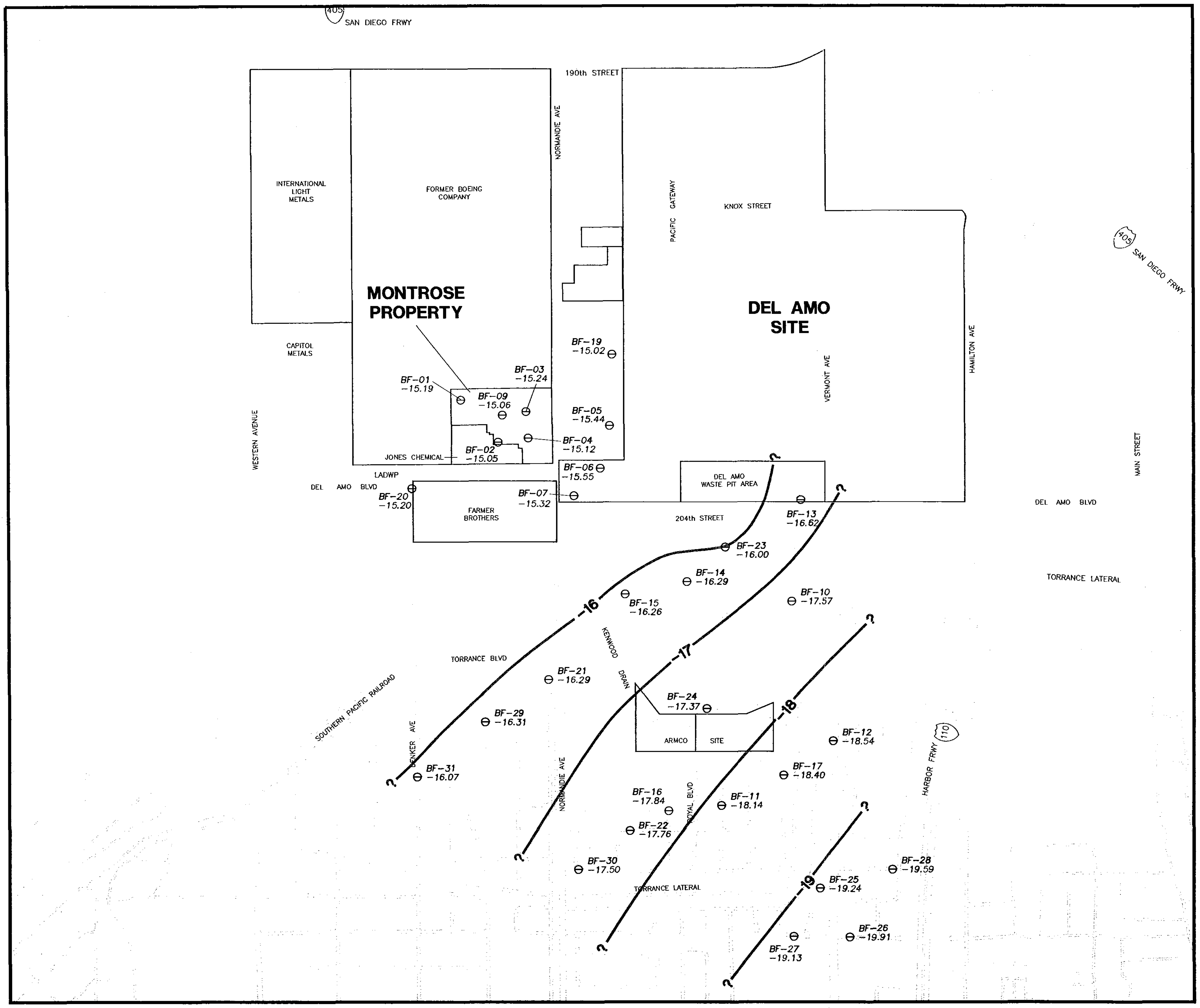
FIGURE 3

PREP BY EJB REV BY MAP RPT NO. 857.38 | 220-1481 | A



EXPLANATION

BF-07 BELLFLOWER SAND MONITOR WELL

-15.32 WATER LEVEL ELEVATION FEET MEAN SEA LEVEL

? —— -18 —— ? CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED.

NOTE: WATER LEVELS MEASURED JANUARY 12-14, 2004
WATER LEVELS AT BF-01, BF-03, BF-06, BF-09, BF-10 MEASURED FEBUARY 6, 2004

N

0 1,000 2,000

FEET

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BELLFLOWER SAND WATER LEVEL ELEVATION JANUARY 2004

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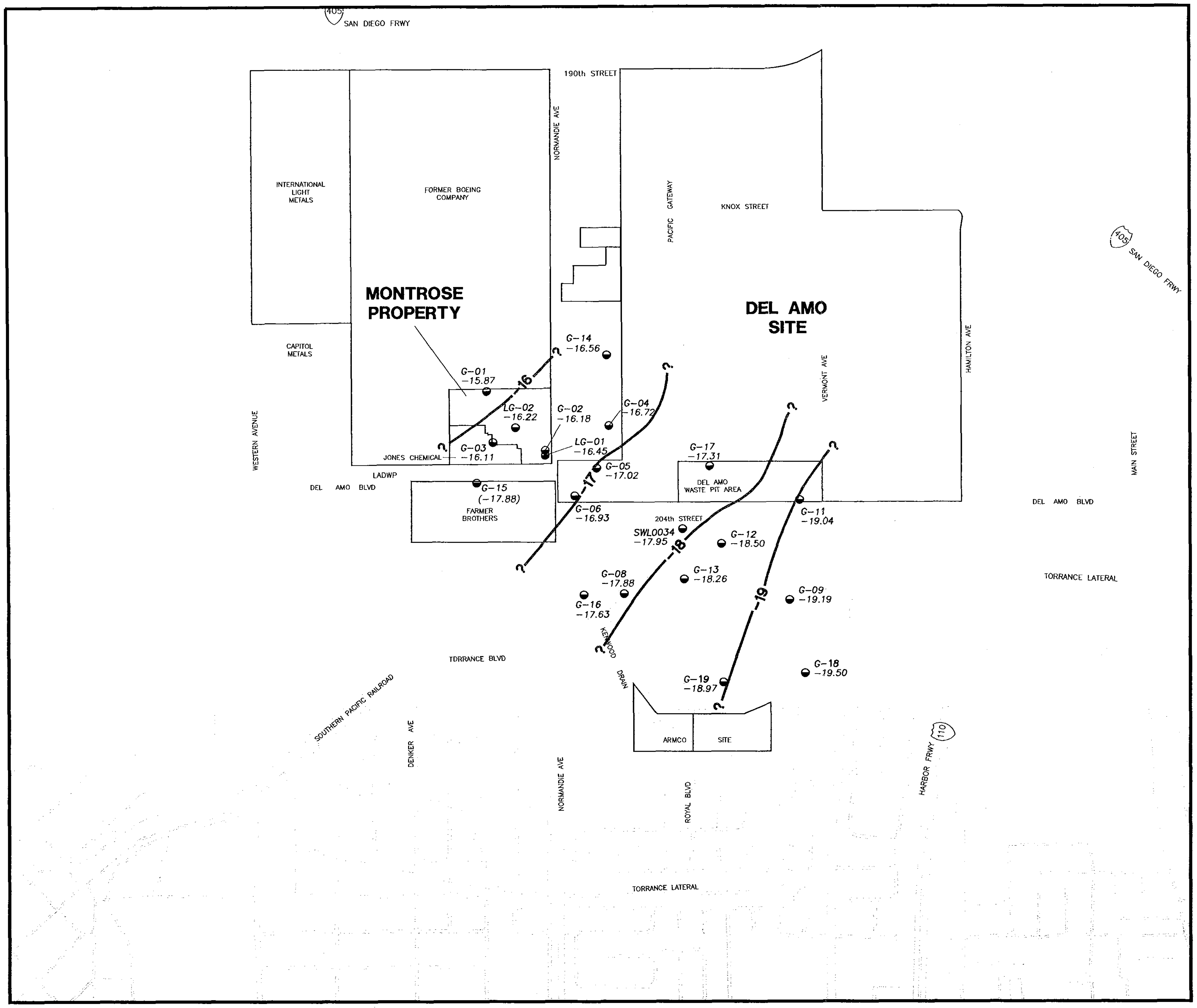
FIGURE 4

PREP BY EJB	REV BY MAP	RPT NO. 857.38	220-1478	A



EXPLANATION

G-04 GAGE AQUIFER MONITOR WELL

-16.72 WATER LEVEL ELEVATION FEET MEAN SEA LEVEL

( ) NOT CONTOURED

? —— -18 —— ? CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED.

NOTE: WATER LEVELS MEASURED JANUARY 12-19, 2004

0 1,000 2,000
FEET

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TORRANCE, CALIFORNIA

GAGE AQUIFER
WATER LEVEL ELEVATION
JANUARY 2004

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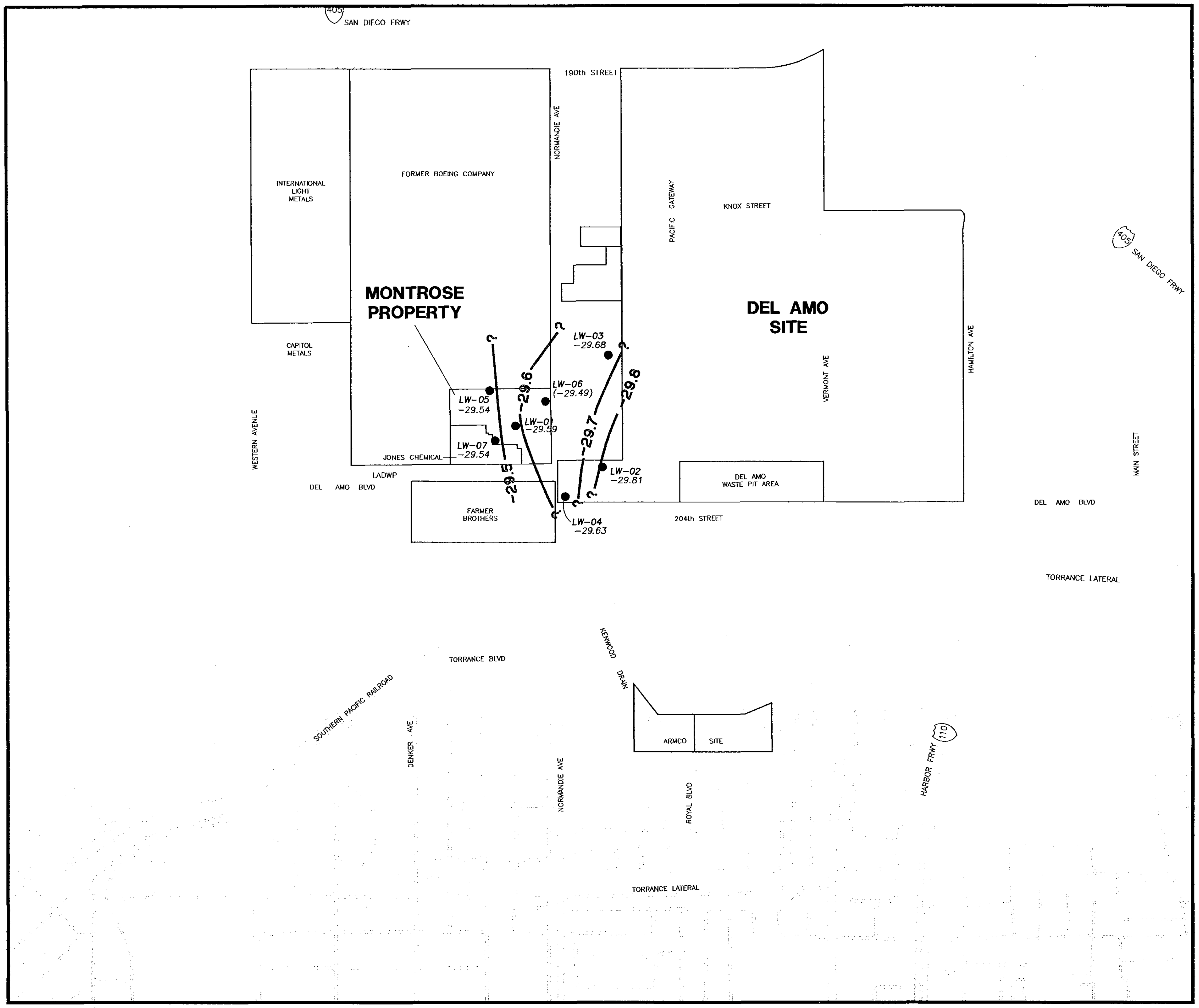
05/04

FIGURE 5

PREP BY EJB REV BY MAP RPT NO. 857.38 220-1479 A

BOE-C6-0012867



EXPLANATION

LW-01 ●	LYNWOOD AQUIFER MONITOR WELL
−29.59	WATER LEVEL ELEVATION (FEET MEAN SEA LEVEL)
( )	NOT CONTOURED

? ——— 29.7 ——— ?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED.

NOTE: WATER LEVELS MEASURED JANUARY 12–13, 2004

N

0 1,000 2,000

FEET

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LYNWOOD AQUIFER WATER LEVEL ELEVATION JANUARY 2004

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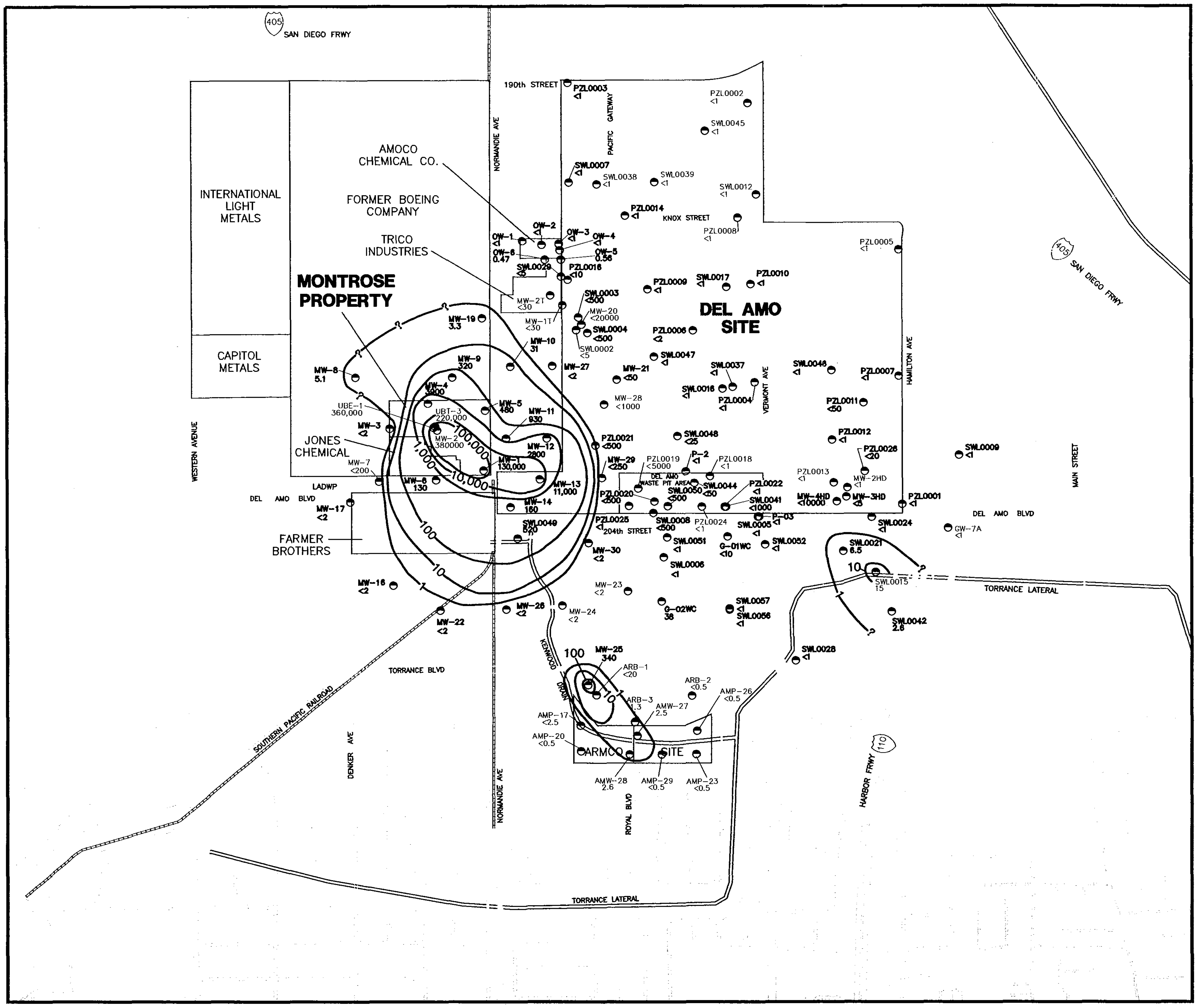
FIGURE 6

PREP BY EJB REV BY MAP RPT NO. 857.38 | 220-1482 | A



EXPLANATION

MW-17	UPPER BELLFLOWER AQUITARD MONITOR WELL
<2	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004.
3.4	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO 2004.
(8.4)	CONCENTRATION NOT CONTOURED

?——1,000—— ——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
- MW = MONTROSE MONITOR WELLS
- SWL, PZL, GW, P, AND MW-_HD = DEL AMO MONITOR WELLS
- AMW, AMP, AND ARB = ARMCO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

N

0 1000 2000

FEET

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TORRANCE, CALIFORNIA

CHLOROBENZENE
UPPER BELLFLOWER AQUITARD

HARGIS + ASSOCIATES, INC.
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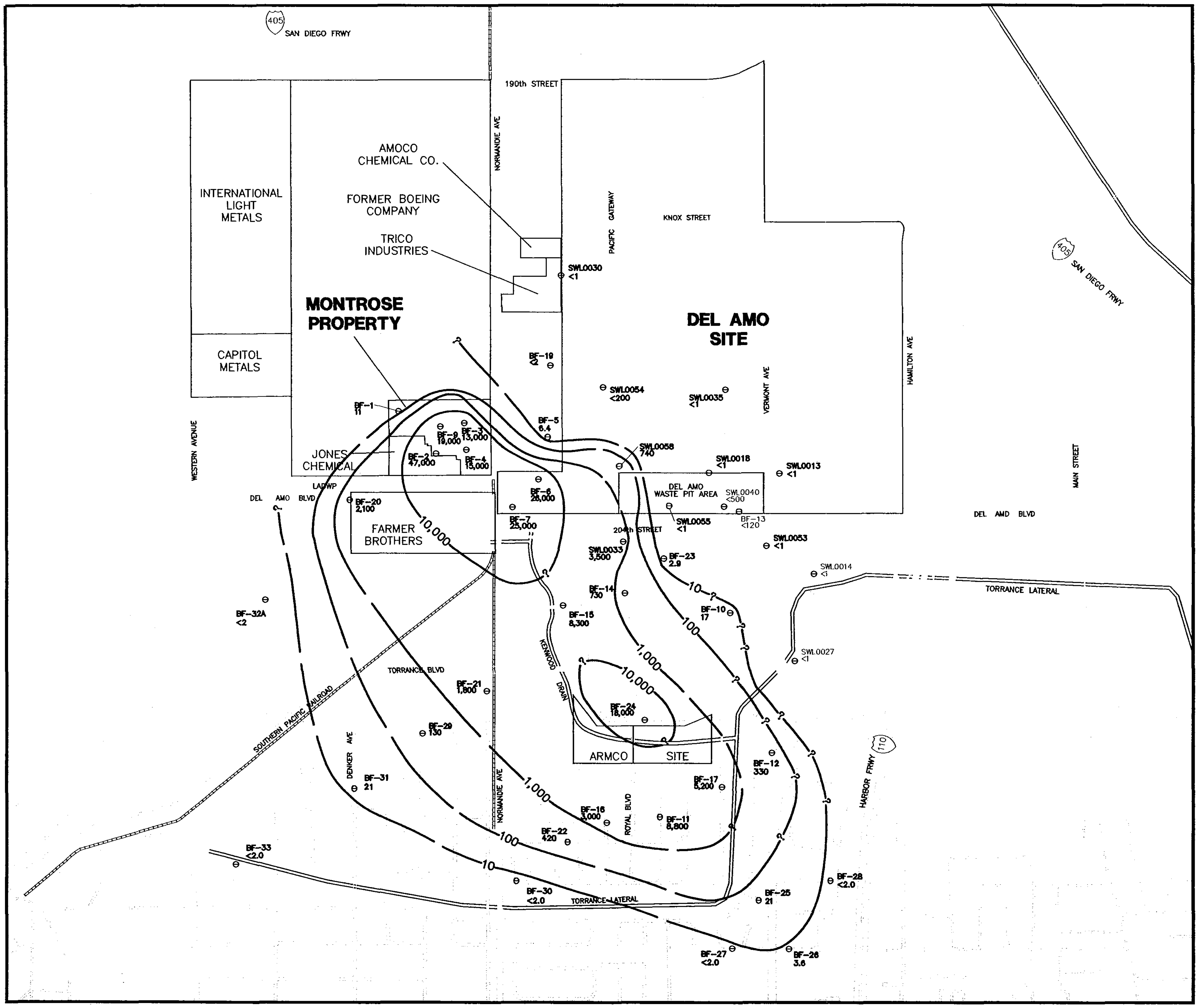
FIGURE 7

PREP BY EJB REV BY MAP RPT NO. 857.38 | 210-2289 | A



EXPLANATION

BF-15 ⊖ BELLFLOWER SAND MONITOR WELL

8,300 CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004.

270 CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO 2004.

?———100——— ———?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

N

0 1000 2000

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROBENZENE
BELLFLOWER SAND

HARGIS + ASSOCIATES, INC.
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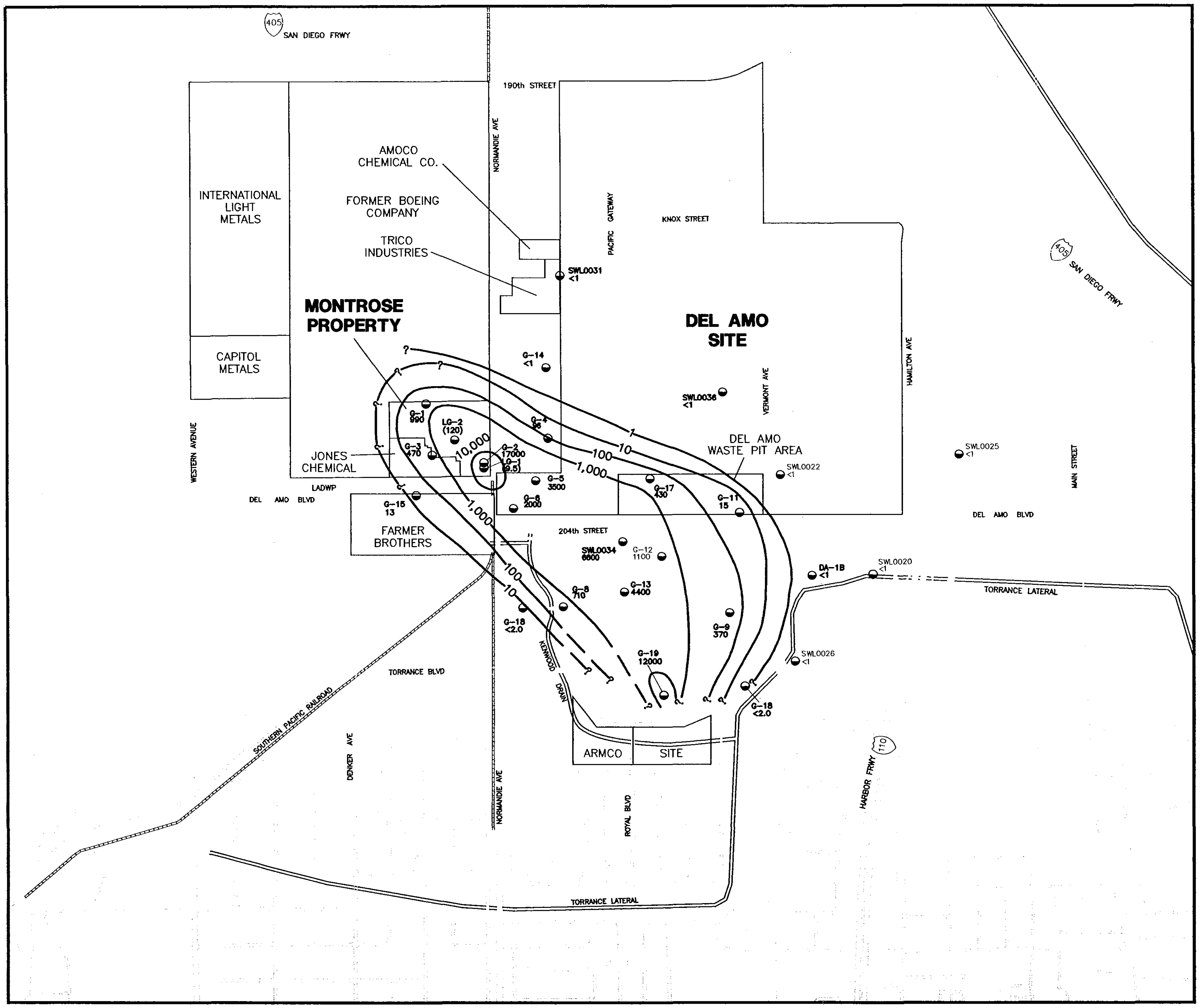
05/04

FIGURE 8

PREP BY EJB REV BY MAP RPT NO. 857.38 210-2290 A



EXPLANATION

G-4 GAGE AQUIFER MONITOR WELL

96 CONCENTRATION IN MICROGRAMS PER LITER, SAMPLEO JANUARY 2004.

<1 CONCENTRATION IN MICROGRAMS PER LITER, SAMPLEO PRIOR TO 2004.

LG-2 LOWER GAGE AQUIFER MONITOR WELL CONCENTRATION IN MICROGRAMS PER LITER

(120) NOT CONTOUREO

?———100——— ——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER OASHEO WHERE APPROXIMATE, QUERIEO WHERE INFERREO BASEO ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF OETECTION FOR THIS ANALYSIS.

WELL IOENTIFIER NOTES:
G ANO LG = MONTROSE MONITOR WELLS
OA ANO SWL = OEL AMO MONITOR WELLS

NOTE: CONCENTRATION OATA FOR OEL AMO MONITOR WELLS PROVIOEO BY URS, 2004.

WATER QUALITY OATA PRESENTEO ON THIS MAP ARE THE MOST RECENT OATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTEO WITH AVAILABLE OATA OBTAINEO BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATEO IN THE SITE VICINITY.

N

0 1000 2000

FEET

MONTROSE CHEMICAL CORPORATION
OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROBENZENE
GAGE AQUIFER

HARGIS + ASSOCIATES, INC.
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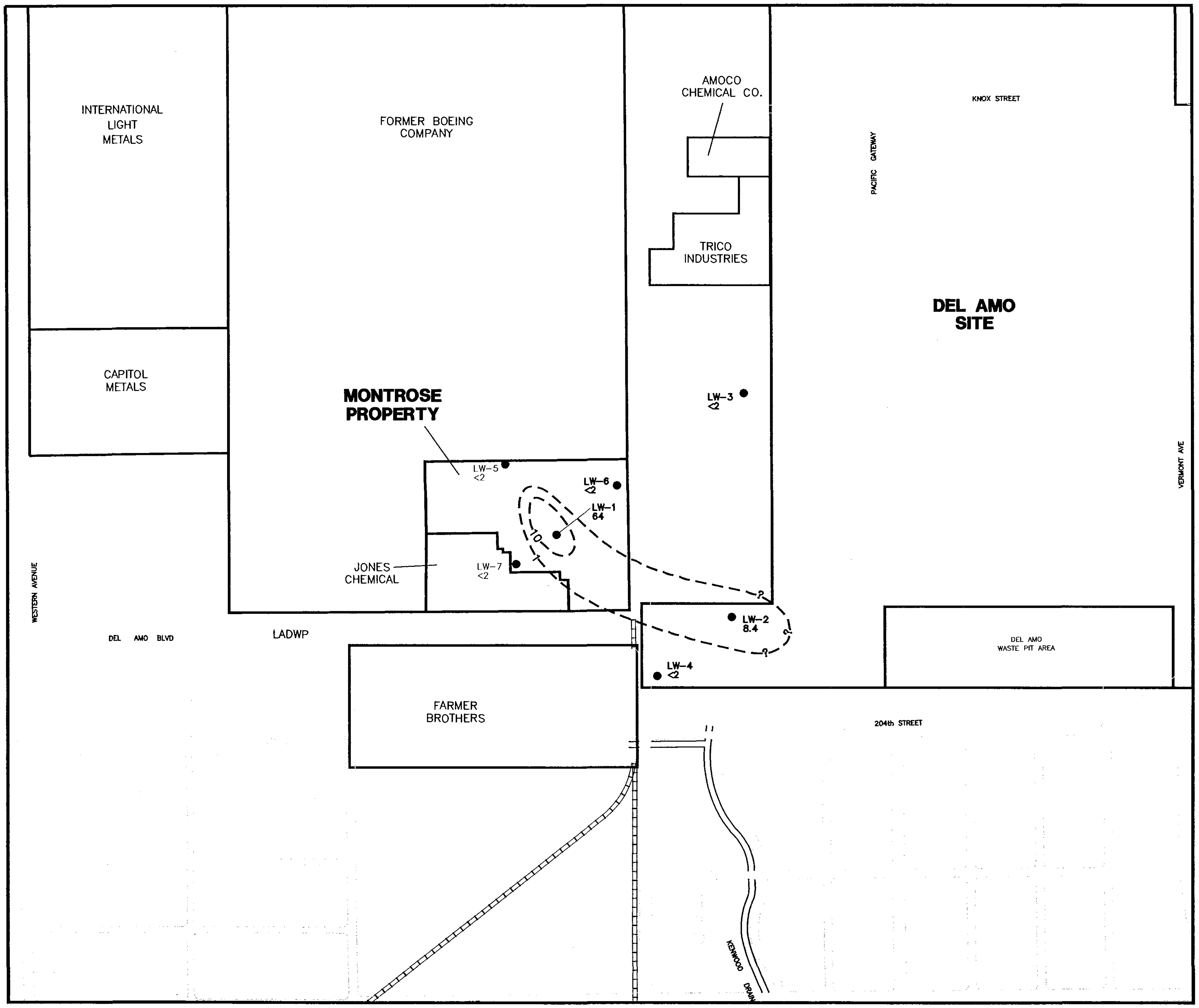
05/04

FIGURE 9

PREP BY EJB REV BY MAP RPT NO. 857.38 | 210-2291 | A



EXPLANATION

LW-4 ● LYNWOOD AQUIFER MONITOR WELL

<2 CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004.

<2 CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO JANUARY 2004.

?———100——— ——?
CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

N

0 500 1000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

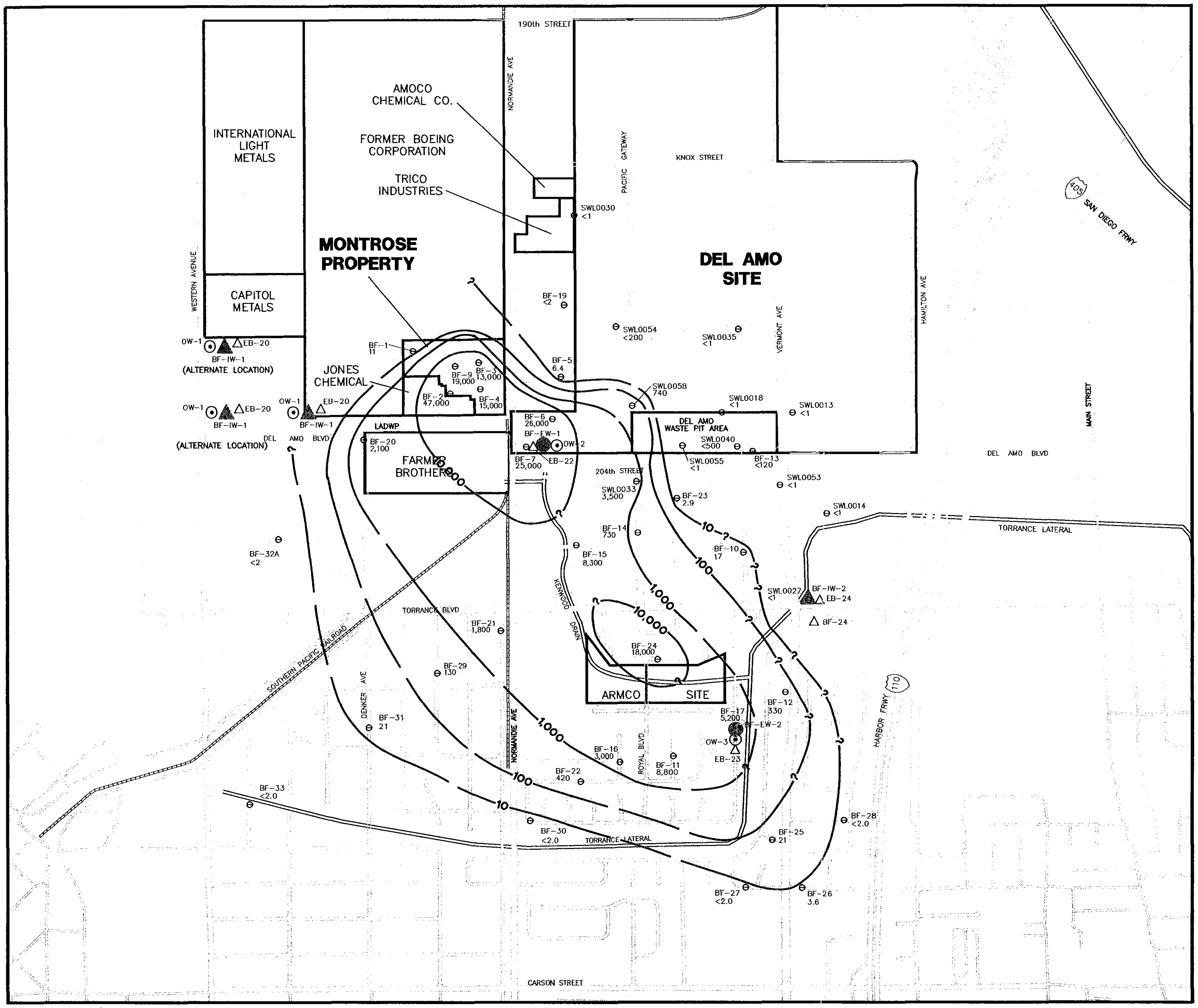
CHLOROBENZENE
LYNWOOD AQUIFER

HARGIS+ASSOCIATES, INC.
Hydrogeology/Engineering

05/04

FIGURE 10

PREP BY EJB REV BY MAP RPT NO. 857.38 | 210-2292 | A



EXPLANATION

BF-15 — BELLFLOWER SAND MONITOR WELL

8,300 — CONCENTRATION IN MICROGRAMS PER LITER

PROPOSED PILOT TEST INJECTION WELL

PROPOSED PILOT TEST EXTRACTION WELL

PROPOSED OBSERVATION WELL

PROPOSED EXPLORATORY BORING

?———— 100 ———— ———?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

N

0 1,000 2,000

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PROPOSED PILOT TEST EXTRACTION–INJECTION WELL LOCATIONS BELLFLOWER SAND

HARGIS + ASSOCIATES, INC.
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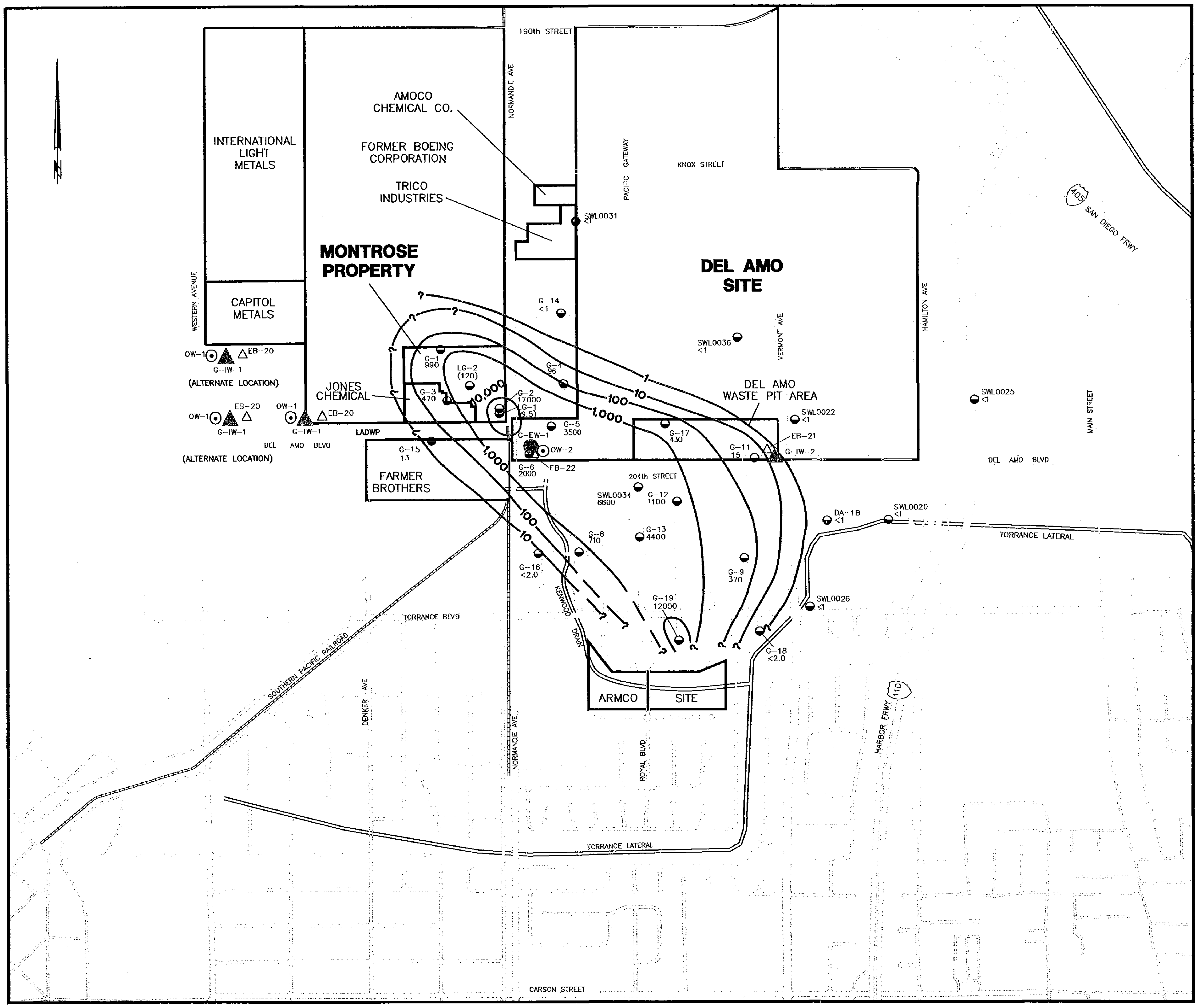
09/04

FIGURE 11

PREP BY PSR REV BY MAP RPT NO. 857.38 | 410-4654 | B



EXPLANATION

G-4 GAGE AQUIFER MONITOR WELL

96 CONCENTRATION IN MICROGRAMS PER LITER

LG-2 LOWER GAGE AQUIFER MONITOR WELL

(309) (CONCENTRATION NOT CONTOURED)

PROPOSED PILOT TEST INJECTION WELL

PROPOSED PILOT TEST EXTRACTION WELL

PROPOSED OBSERVATION WELL

PROPOSED EXPLORATORY BORING

?——100——? CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
G AND LG = MONTROSE MONITOR WELLS
DA AND SWL = DEL AMO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

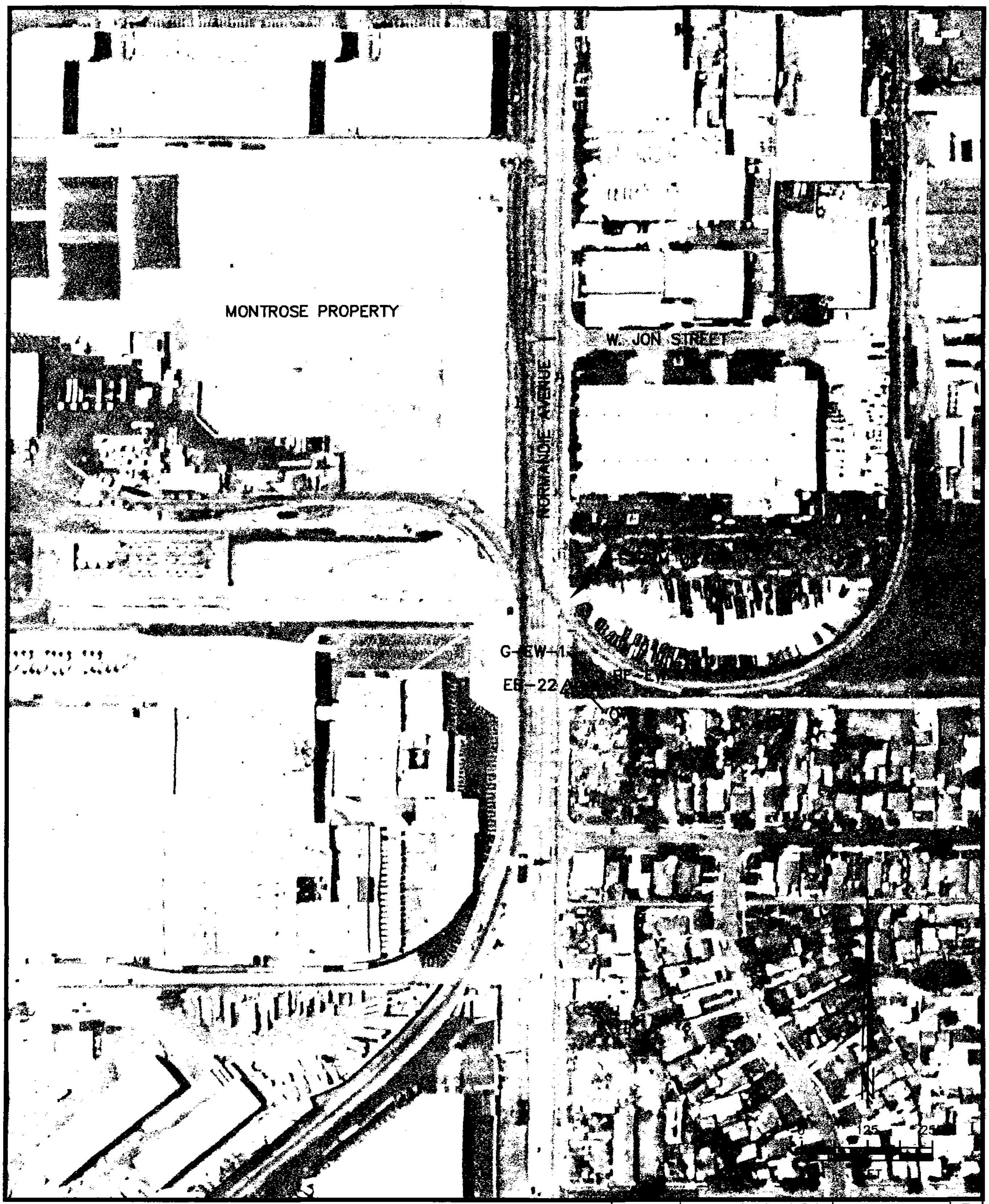
0 1,000 2,000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

PROPOSED PILOT TEST EXTRACTION-INJECTION WELL LOCATIONS GAGE AQUIFER

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering
10/04
FIGURE 12

PREP BY PSR REV BY MAP RPT NO. 857.38 410-4655 B



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10/04	RPT NO. 857.38	410-4675	B

FIGURE 13.
STORM DRAIN LOCATIONS FOR EXTRACTION WELL BF-EW-1 AND G-EW-1

10/04	RPT NO. 857.38	410-4882	B

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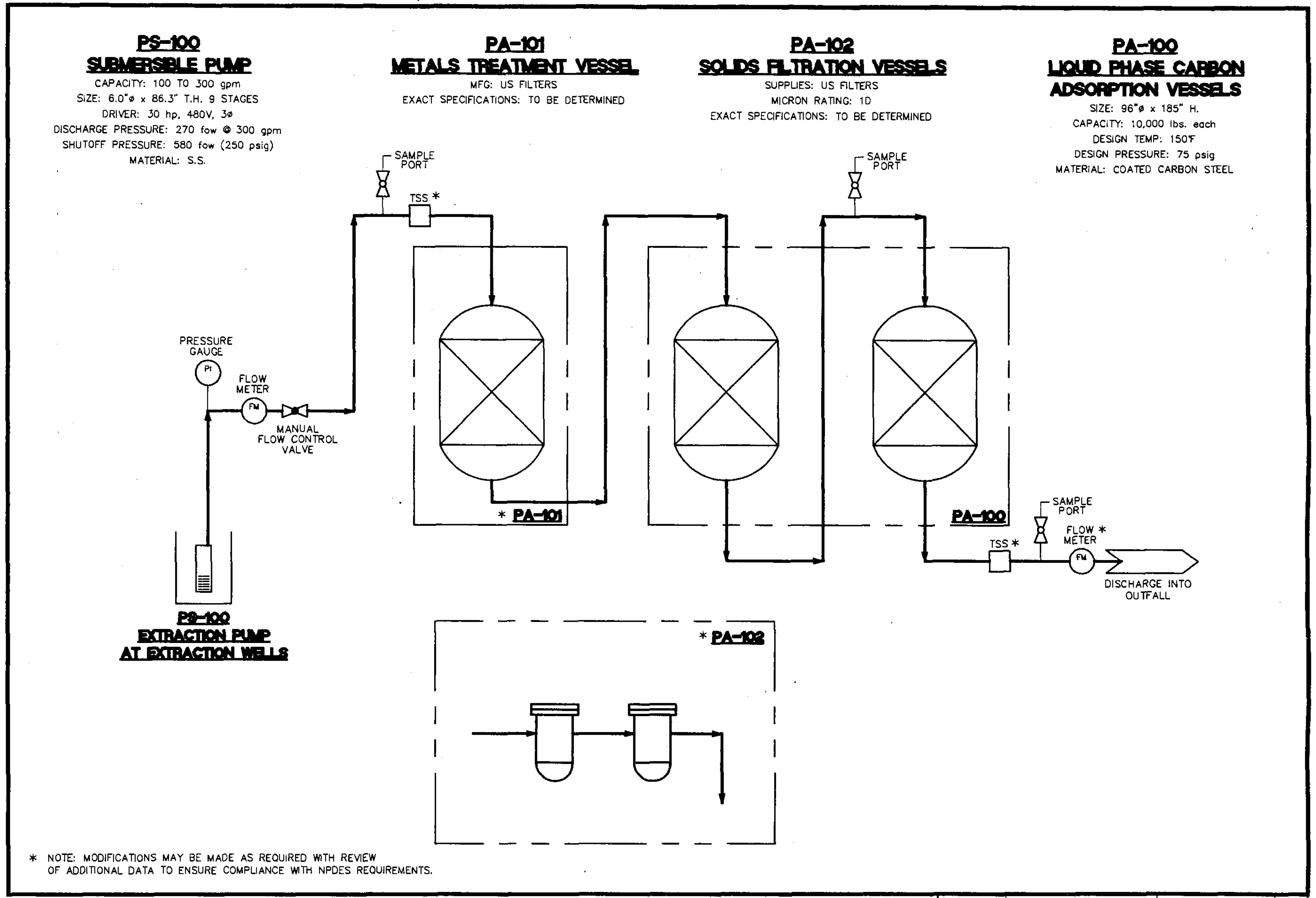
FIGURE 14.
STORM DRAIN LOCATION FOR
EXTRACTION WELL BF-EW-2



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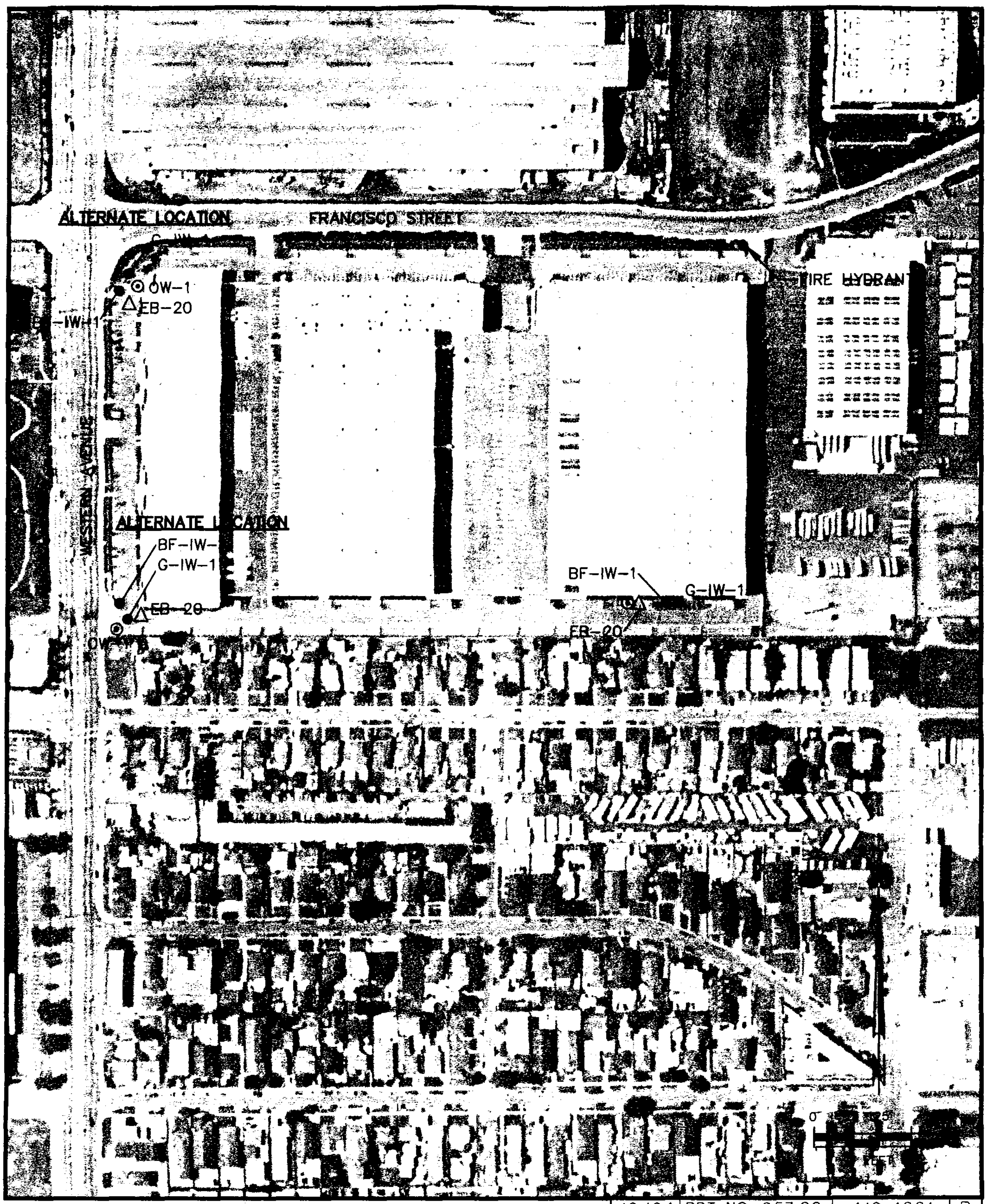
10/04	RPT NO. 857.38	560-0160	B

FIGURE 15. PILOT EXTRACTION TREATMENT SYSTEM PROCESS FLOW DIAGRAM



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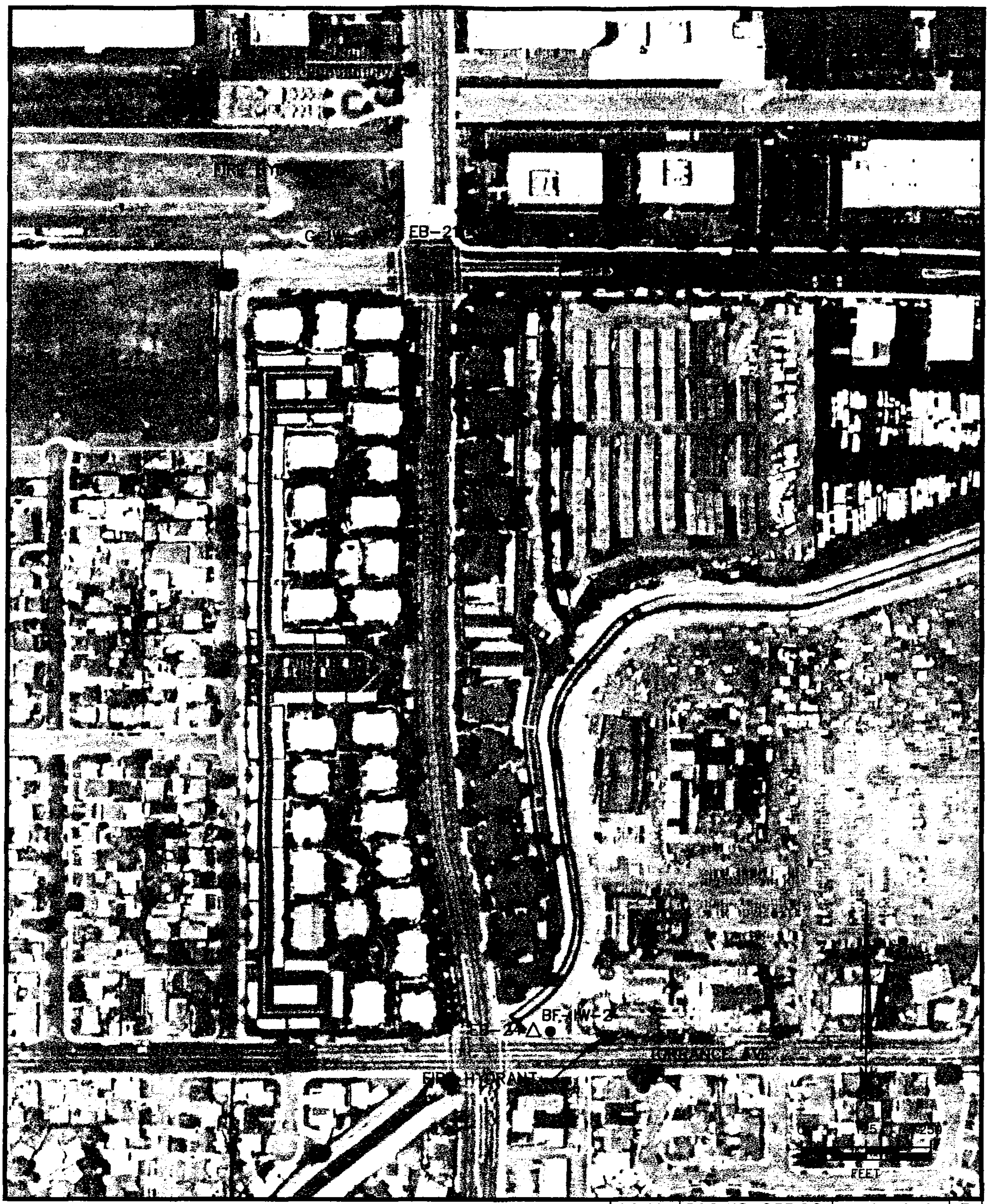
10/04	RPT NO. 857.39	410-4881	B

FIGURE 16.
FIRE HYDRANT LOCATION FOR
INJECTION WELL BF-IW-1 AND G-IW-1



08/04	RPT NO. 857.38	410-4676	B

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FIGURE 17.
FIRE HYDRANT LOCATION FOR INJECTION WELL BF-IW-2 AND G-IW-2

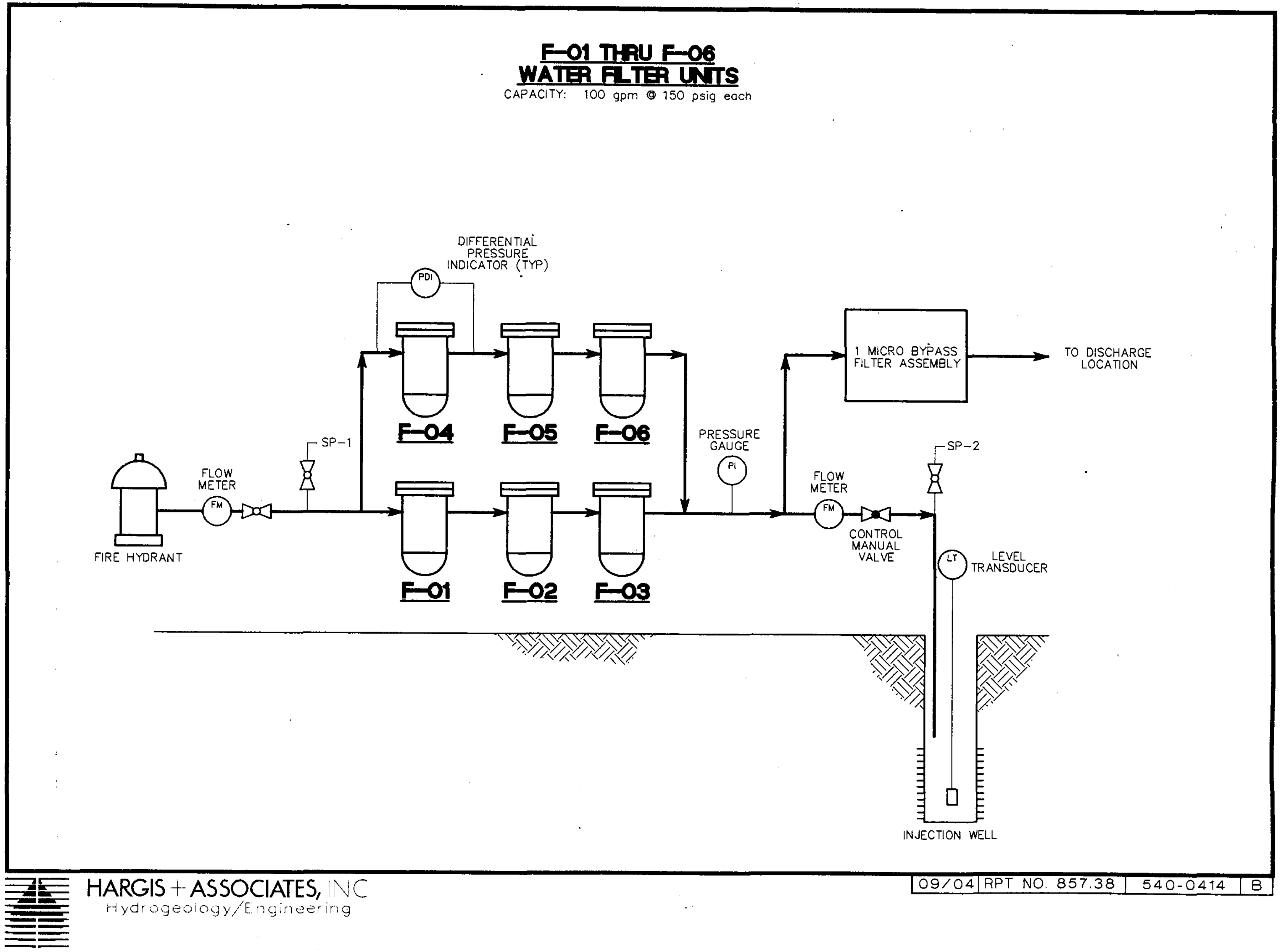
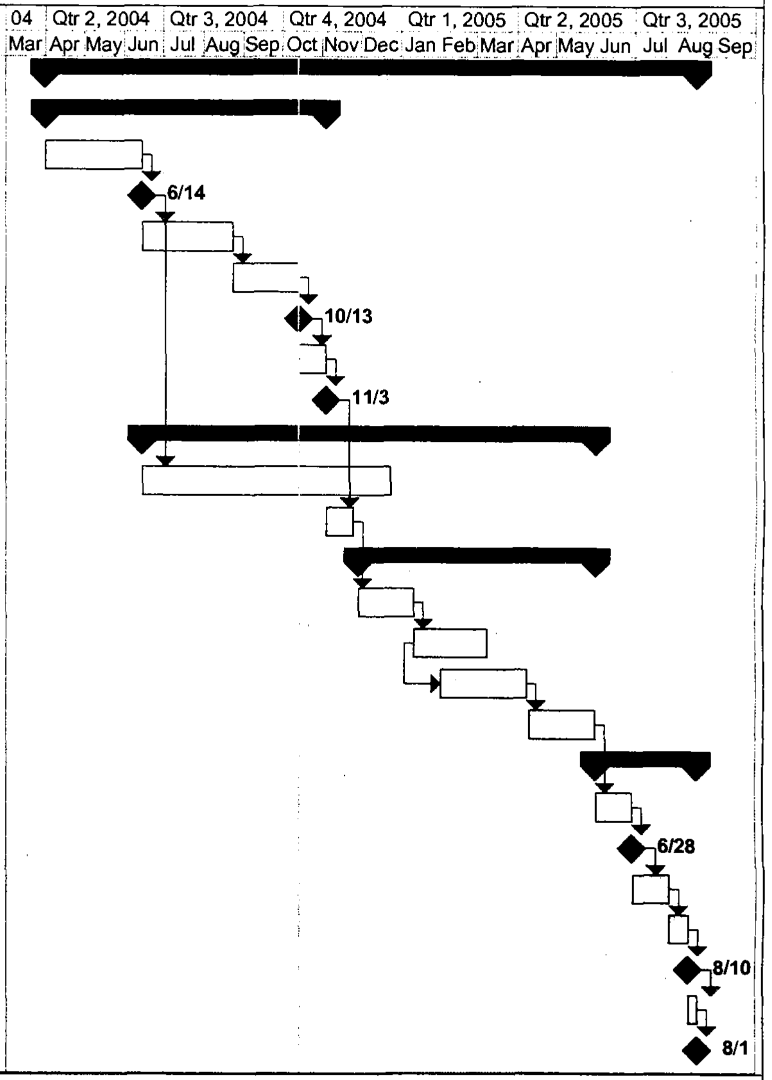


FIGURE 18. INJECTION SYSTEM PROCESS FLOW DIAGRAM

BOE-C6-0012880

Figure 19
Schedule

ID	Task Name	Duration	Start	Finish
1	**Pilot Extraction and Aquifer Response Test**	**346 days**	**Thu 4/1/04**	**Wed 8/17/05**
2	**Workplan/FSP/QAPP-DIN 036**	**152 days**	**Thu 4/1/04**	**Wed 11/3/04**
3	Prepare Plan/Montrose Review	52 days	Thu 4/1/04	Mon 6/14/04
4	Submit Draft to EPA	0 days	Mon 6/14/04	Mon 6/14/04
5	EPA Review	49 days	Tue 6/15/04	Mon 8/23/04
6	Revise Plan	36 days	Tue 8/24/04	Wed 10/13/04
7	Submit Final to EPA	0 days	Wed 10/13/04	Wed 10/13/04
8	EPA Review	15 days	Thu 10/14/04	Wed 11/3/04
9	EPA Approval	0 days	Wed 11/3/04	Wed 11/3/04
10	**Pilot Testing**	**238 days**	**Tue 6/15/04**	**Tue 5/31/05**
11	Access and Permitting	134 days	Tue 6/15/04	Thu 12/23/04
12	Mobilization	15 days	Thu 11/4/04	Wed 11/24/04
13	**Fieldwork**	**123 days**	**Mon 11/29/04**	**Tue 5/31/05**
14	Exploratory Borings/Observation wells	24 days	Mon 11/29/04	Mon 1/10/05
15	Install Extraction/Injection Wells	40 days	Tue 1/11/05	Tue 3/8/05
16	Injection Testing	48 days	Tue 2/1/05	Fri 4/8/05
17	Extraction Testing	36 days	Mon 4/11/05	Tue 5/31/05
18	**Completion Report DIN 037**	**56 days**	**Wed 6/1/05**	**Wed 8/17/05**
19	Prepare Report/Montrose Review	20 days	Wed 6/1/05	Tue 6/28/05
20	Submit to EPA	0 days	Tue 6/28/05	Tue 6/28/05
21	EPA Review	20 days	Wed 6/29/05	Tue 7/26/05
22	Revise Report	11 days	Wed 7/27/05	Wed 8/10/05
23	Submit Final to EPA	0 days	Wed 8/10/05	Wed 8/10/05
24	EPA Review	5 days	Thu 8/11/05	Wed 8/17/05
25	EPA Approval	0 days	Wed 8/17/05	Wed 8/17/05



Project: 857 Rpts 2004-10 Fig 19 Sche
Date: Wed 10/13/04

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

BOE-C6-0012881